THERMAL FITNESS OF CANADA'S HOUSING STOCK: A THERMOGRAPHY/ PHOTOGRAPHY SURVEY

Final report to:

Jack Smith
Conservation and Renewable
Energy Branch
Energy, Mines & Resources,
Canada

By:

Scanada Consultants Limited
Oakville and Ottawa

Field Surveyors:
Thermoscan, St. John's
Enertek, Fredericton
Les Consultants en Conservation
de l'Energie, Montréal
ITA, London
Thermal Energy Consultants,
Winnipeg
Infraview and Surescan,
Vancouver and Victoria
and Infratech, Division of
Scanada

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THERMAL FITNESS OF CANADA'S LOW-RISE HOUSING STOCK: A THERMOGRAPHY / PHOTOGRAPHY SUMMARY

EXECUTIVE SUMMARY

How many houses still have uninsulated walls or basements, how many are very air-leaky; are many poorly insulated; are many troubled by excessive moisture within the structure? Where are these "thermally unfit" units that represent the remaining potential market for "energy retrofit" programs, incentives, and strategies, public and private? What types, constructions and general conditions characterize this market across Canada?

Commissioned by Energy, Mines and Resources, seven teams of surveyors set out in March 1982 to help answer these questions - by scanning very broad samples of the housing stock by means of special street-level thermography/photography* traverses. Scanning the front and one end of each unit, the teams "captured" 13,788 units on film and video-thermography tapes. The traverses were laid out to criss-cross the neighborhoods of various ages throughout several Census Metropolitan Areas, the surveyors maintaining a balance of numbers within each age group representative of the region's stock.

Mild weather (which prevents clear thermography) caused only one structural gap in the commissioned survey: Vancouver could not be scanned at all. The teams reshuffled and added to their Western runs as well as possible, capturing the overall stock well beyond the contract stipulations:

- St. John's - 1,314 units, roughly balanced cross-section
- Fredericton/Moncton (as "one CMA") - 1,988 units, roughly balanced
- Montreal - 2,003 units, roughly balanced
- Hull - 374 units, roughly balanced

*Infra-red thermography, "heat picturing", is defined in note 2 following the report's Introduction.

- Toronto - 1,697 units, roughly balanced
- London - 2,081 units, roughly balanced
- Winnipeg - 2,008 units, roughly balanced
- Calgary - 744 units, generally balanced but some over-representation of recent stock, counterbalancing the Edmonton survey
- Edmonton - 984 units, generally balanced but some under-representation of recent stock

Plus further runs as weather and logistics permitted:

- Nelson - 77 units, almost all pre-1945
- Victoria - 56 units, almost entirely 1951-'60 bungalows
- Ottawa - 254 units, 41% pre-1945 and 59% post 1961.

The photo and video thermography record yielded these details, house by house:

- Age, Style, Type (and general conditon is also assessable).
- Level of wall insulation - nil, medium, full.
- Completeness of insulation - voids or settlement.
- Basement insulation (very often obscured by snowbanks).
- Gable end insulation.
- Air leak locations and apparent extent.
- Presence of excessive moisture in wall.

The data base was compiled on computer and a preliminary analysis done. Although considerable re-weighting or normalization of numbers is feasible and desirable for better representativeness, the "first picturing" is indeed useful. Some primary results are tabulated in the **Overall Data Summary Table**, overleaf. Break-outs by age groups and CMA are presented in the report (Data Summary Tables), with a generous sampling of thermograms and photographs. The conclusions and recommendations comprise a summary report in themselves.

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OVERALL DATA SUMMARY TABLE - %'s

	STYLE						TYPE						GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE				INSULATION IN:	
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	Nil	Med	Full	Settled	Poor Placement	Voids	Uniform	Low	Med	High	Basement	Attic	
FULL SURVEYS:																									
NFLD	34	4	32		6	24	78		15	4	2	26	5	25	70		1	4	96	10	59	31	41	N/A	
FRED/ MONC	37	20	16	12	4	11	93	5		1		5	4	60	36		7	4	89	67	30	3	18	N/A	
MONT	8	1	59	30	1	1	12	16	54	4	15	[illegible]	50	32	17	3	1	1	96	69	19	12	9	N/A	
TOR	31	12	28	17	11	1	80	19	1			0	70	25	5			1	99	16	76	8	29	N/A	
LOND	36	17	20	1	24	1	96		4			5	4	52	43		1	1	98	33	51	16		N/A	
WINN	65	12	17	3	2	1	98			2		4	54	39	7			2	98	27	59	14	14	N/A	
CALG	55	11	14		9	11	94	5		1		0	2	50	48				100	16	79	4	1	N/A	
EDMN	62	26	4	1		7	98	2				0	9	52	39			2	98	36	56	8	0	N/A	
LIMITED SURVEY - NOT FULLY REPRESENTATIVE OF HOUSING STOCK:																									
HULL	46	14	35	1		5	92	4	3			12	1	44	55				100	60	38	2	44	N/A	
EXTREMELY LIMITED SURVEY - NOT REPRESENTATIVE OF HOUSING STOCK:																									
OTT		1	58	41			40		59	1		0	19	76	5				100	34	46	20	38	N/A	
NEL	17	12	41	8			100					0	42	49	9			1	99	20	80		20	N/A	
VICT	88					11	100					7	8	86	6	14	5	18	63	68	18	13	38	100	

Conclusions and Recommendations:

The survey method works wells: street-level thermography/photography is indeed an effective survey tool that has, in the hands of seven teams,

- defined the present "thermal fitness" levels of the walls of 13,788 houses across Canada, in essentially one critical month before spring 1982. The use of double glazed windows as reference points ("self adjusting" on each house) has yielded an adequate definition of nil, medium and full insulation, with some apparent vagueness between medium and full. On all except some older stock (uninsulated) useful indications of air leakage character and degree were also captured. Presence or absence of basement insulation was revealed in those few cities free from snowbanks.

- delineated the pattern and extent of excessive accumulations of moisture within the walls of some recently built housing and older (retro-insulated) stock

- provided a permanent record of photographs and videotaped thermography that can be referenced and studied much further than in this "first picturing" report, in terms of thermal fitness, earlier or further validation and correlation with earlier or further on-site inspections or moisture probings, for example; and correlation with apparent general condition, regional attributes and socio-economic attributes. Since every unit is identified and traceable by street and number, apparently troubled units or puzzling units can now be selected from the survey and studied definitively in the field.

The thermography/photography interpretations have been formed into a computerized data base from which a rebalanced "first picture" of Canada's low-rise housing has been developed:

- About 18% (1.1 million) of the low-rise stock has completely uninsulated walls. More than half of these are in Toronto and Montreal, primarily solid masonry and plank frame respectively. (These are difficult but now economic to insulate. The remainder are wood frame, easy, safe and most economic to insulate.)

- About 42% or more are moderately insulated in the walls, while 40% or less are fully insulated. (It may be economically worthwhile to add further insulation within or on moderately insulated walls, i.e. presently having R7 or R8 (RSI 1.4) batts.

- Although foundations were hidden by snowbanks in many cities, those that were scanned suggest that only 22-33% of basements are insulated.

- While much of the insulated stock appears to be fairly airtight in the walls and wall-to-roof junctions, 50% appears to be moderately airleaky and 10% highly so.

- Regionally, peculiarities are apparent and significant. In addition to the distinct Toronto and Montreal uninsulated stock, half of Winnipeg's housing is uninsulated in the walls, probably due to the postwar sweep of double aluminum foil "insulation" in that region particularly. One third of St. John's newer housing appears to be signficiantly troubled with excessive moisture within the walls. (St. John's walls also appear more air leaky than generally observed elsewhere.) One tenth of older housing on both coasts appears to have similar accumulations, but this often appears to be due to rundown of water from attic condensation (and/or ice dams) in these older houses. Similar patterns were seen in older houses in Moncton/Frederiction, Hull and London, and in Winnipeg to a lesser extent. (Due to mild weather, it

was not possible to scan any newer houses on the West Coast; insulation and moisture questions there are left largely unanswered.)

Recommendations

The data base should be reviewed for maximum utilization, carrying out adequate validation and gap-filling where needed. For example, in no order of priority:

- Analysis and correlation of obvious retrofit insulation, and nil insulation, with wall and attic moisture problems.

- Follow-up scanning and field probes of moisture "flagged" houses in early winter to see if summer drying has taken place.

- Quick re-scanning of the several cities that were snow-blocked, especially to complete the picture of basement insulation.

- Analysis of data base, and field probing, to determine if there is indeed a strong correlation between excessive structural moisture and air leaky walls / raised basement houses / flueless houses / full insulation, in recently built stock especially on the coasts.

- Field probing of Winnipeg/Toronto/Montreal uninsulated stock: Is it primarily what the surveyors think it is?; Is it insulatable?

- Production of a basic Low-Rise Canada reference book delineating the stock (by age by region) in terms of physical and thermal condition - for public and private sector use.

- Revamping and updating the "Canada Model" approach to project quantifications of conserver measures, effects, costs, cost-benefits, resource demands, public and private sector policy opportunities.

THERMAL FITNESS OF CANADA'S HOUSING STOCK: A THERMOGRAPHY / PHOTOGRAPHY SURVEY

Final Report to Jack Smith, Energy, Mines & Resources, Canada

From: Scanada Consultants Limited
Oakville and Ottawa, September 27, 1982

	Page
1. INTRODUCTION With definitions, references and final scope.	1
2. OVERVIEW OF METHOD Reference Appendix A.	4
2.1 FIELD SURVEY PROCEDURE	4
2.2 COMPUTER BASE STRUCTURE	6
2.2.1 Basic Data	6
2.2.2 Analysis Program	7
3. REGIONAL FINDINGS	8
3.1 THERMOGRAPHY / PHOTOGRAPHY COVERAGE: TYPICAL EXAMPLES	8
3.2 THERMOGRAPHY / PHOTOGRAPHY COVERAGE: "THERMALLY UNFIT" EXAMPLES	25
3.3 DATA SUMMARY TABLES	29
4. FIRST ANALYSIS OF FINDINGS	42
- OVERALL DATA SUMMARY TABLE	43
4.1 LIMITATIONS	42
4.1.1 Weather	42
4.1.2 Representing Whole CMA's	44
4.1.3 Air Leakage	45
4.1.4 Attic Insulation	45
4.1.5 Exterior Cladding Effects	46
4.2 FIRST ANALYSES	46
4.2.1 The Housing Stock	46
4.2.2 Thermal Fitness - Insulation	47
4.2.3 Thermal Fitness - Air Leakage	48
4.2.4 Moisture within the Walls	49
4.2.5 Low-Rise Canada: A First Picture	50
5. CONCLUSIONS AND RECOMMENDATIONS	53

APPENDIX A: HOUSING THERMOGRAPHY / PHOTOGRAPHY SURVEY: TECHNICAL GUIDELINES

UNDER SEPARATE COVER: DATA CORRELATION TABLES

THERMAL FITNESS OF CANADA'S HOUSING STOCK: A THERMOGRAPHY/PHOTOGRAPHY SURVEY

1.0 INTRODUCTION AND SCOPE

What is the present thermal condition of Canada's low-rise housing stock? What portion of this stock is insulated, and to what degree? How many houses still lack basement insulation, wall insulation, reasonable airtightness or double glazing? Are many insulated houses, new and old, plagued with excessive moisture in their insulation and structure, which can reduce both thermal fitness and useful life? What types, styles, ages, constructions and finishes characterize the low rise housing stock across Canada? How does "thermal fitness" appear to vary with these basic characteristics?

Answers to these questions would allow more meaningful analysis and accurate modelling[1] of Canada's housing energy realities, including estimation of the potential "market" for "energy retrofit". Costs of energy conservation and retrofit programs, including demands on material, labour, capital and energy resources, and potential savings as well as spin-off opportunities would become more reliably quantifiable. This knowledge of costs/benefits would allow better appreciation of the need for, scope and design of incentive programs, leverages, promotions and ventures. These answers would provide an information base of value to policymakers in both public and private sectors.

In February 1982 Energy, Mines and Resources Canada, as part of its research program to estimate the economic and technical potential for retrofit, initiated a Canada-wide, street level "Housing Thermography/ Photography Survey" to help create a data base answering many of these questions.[2] EMR called for an intensive effort to gather a comprehensive picture of the low-rise residential stock before the end of March 1982, since the survey would require ideal nighttime winter conditions for definitive

thermal scanning. The work required the use of nighttime video thermography as well as daytime photography, all in the short winter period from late February through March. At least seven Census Metropolitan Areas across Canada were to be surveyed. The survey concept involved the laying out of traverses in each CMA designed to cross-section older and newer neighborhoods representatively and thus "capture" each age group of houses adequately. Cold weather held until early April, allowing the successful picturing of 13,788 units.[3]

Obviously, the singular early priority was the set up and execution of a broad survey with maximum speed, so as to complete the picturing of the housing stock before winter's end. Once all the data was gathered and fully documented with complete identification (referenced always to specific street addresses) a second phase was carried out, transferring the whole data base to computer and then producing initial breakouts and correlations "as found" in terms of present or potential thermal concerns. The following information comprises a summary final report of the street level "Housing Thermography/ Photography Survey" of 13,788 Canadian residential housing units, and offers a technical profile and a first analysis of the housing thermal picture "as found" in 1982.

1. The construction of the current model, "Canada 2", required the use of some questionable data and tenuous guesses, as stated at the time. Because some of these inputs did err, this model appears to overstate present thermal quality (particularly, the extent of basement insulation), and hence understates potentials for upgrading. "Canada 2" is set out in: HEATING CANADIAN HOUSES: CURRENT PERFORMANCE AND POTENTIAL FOR IMPROVEMENT, prepared for Canada Mortgage and Housing Corporation by Scanada Consultants Limited, March 1979.

2. Thermography uses infrared photography to record apparent surface temperature distribution on thermograms, or "heat pictures". On a thermogram light shades indicate high radiation density which usually infers warmer temperatures; on the other hand, darker shades represent progressively colder temperatures. Careful interpretation of thermograms provides considerable information about a building's heat loss characteristics. Common building envelope defects, such as missing, poorly installed or wet insulation, or air leakage points, cause discernable surface temperature variations on floors, walls or ceilings.

   Thermographic surveys can be carried out in three common modes: interior, aerial exterior, and street level exterior. Interior thermography is most definitive, but it has limitations for survey purposes. It requires resident cooperation, and time and costs on a nation-wide scale are prohibitive. Aerial thermography provides economical coverage of whole communities, but has very limited definition. It is eminently suitable for large flat roof areas, e.g. commercial-industrial-institutional. Street-level exterior thermography combines meaningful definition of walls and windows with great advantages of speed, unobtrusiveness and low cost, and is thus the favoured tool for broad surveying of housing.

3. The survey initially was intended to cover a target number of 2,000 housing units in each of the following areas: St. John's, Newfoundland; Fredericton/Moncton, New Brunwsick; Montreal, Quebec; Toronto, Ontario; London, Ontario; Winnipeg, Manitoba; and Vancouver, British Columbia. Selected runs were called for in Ottawa, Ontario and Hull, Quebec to help provide better coverage of these two provinces.

   It proved impossible, however, to survey Vancouver due to weather conditions. Therefore, to help represent Western Canada small runs in Victoria and Nelson, British Columbia, were substituted along with more substantial runs in Calgary and Edmonton, Alberta.

2.0 OVERVIEW OF METHOD

2.1 FIELD SURVEY PROCEDURE

In February 1982, Scanada Consultants Limited developed field survey procedures under the title "Housing Thermography/Photography Survey - Technical Guidelines and Specifications" and distributed these Guidelines to seven regional thermography contractors. The intent was to establish consistent scanning procedures and report formats for data collection and interpretation for the thermography surveys carried out across Canada during the months of February and March 1982. The Guidelines addressed the following areas: Preparation for Field Runs, Collection of Non-IR (non- infrared) Field Data, Collection of IR Field Data, and Weather Restrictions. Examples of Completed Route Maps and Completed Tables were included. (See Appendix A.)

These specifications were designed to help ensure consistent application of the video and 35 mm thermography. Just prior to the main work, several field trial runs established that double glazed windows could be used as a reliable temperature benchmark. When the infrared detector is set to record the window units at one level, the wall insulation levels and quality become consistently interpretable. Use of this benchmark, which is "self regulating" for each house, avoids errors due to thermostat setback or unheated rooms (which otherwise could have given a false "insulation" inference). The benchmark also ensures that thermography evaluation from Newfoundland to Victoria remains comparable. (The procedure is outlined under "Collection of IR Field Data" in Appendix A.)

To utilize the available night scanning time fully and permit quick drive-throughs, hard copy thermal records of each house were made as video tapes and 35 mm thermograms. During daytime, 35 mm colour slides or colour video tapes were taken of each house.

In the field, voice recording of comments on the video thermography tapes, and written tabulation of results and interpretations (Appendix A) allowed a maximum of data gathering and fresh interpretation in a minimum of time while permitting extensive follow-up and further verification. The tabulations were also designed for easy coding to computer. The field recordings and tabulations were verified later by Scanada by visual review of the thermographic and photographic records. (Video thermography records the infrared "signals" precisely as received and allows the viewer to replay and manipulate the image later just as if on site. For example, the display can be resolved to isotherms that help differentiate moisture from other anomalies.)

Prior to the field surveys, a meeting was held with each contractor in each region to review the guidelines and to examine the local conditions that might affect the survey. Assistance was given in obtaining maps and establishing the basic sampling approach of laying out random traverses that would capture numbers of houses proportional to the region's total stock in each age group. Daylight viewing and colour photography allowed all houses to be "aged" in the field, and verified later from the photo records, by knowledge of local styles, customs and materials. The thermography itself differentiated between constructions (e.g. balloon frame vs. platform frame) and this also helped in judging the age bracket.

The specifications defined the required weather conditions for the survey. In order to complete the last of the work, contractors were requested to take advantage of the best (coldest) available nights even if the ideal conditions were not occurring. Any variance from the outlined weather conditions was clearly documented so that it could be taken into account during the interpretations of the thermograms.

2.2 COMPUTER BASE STRUCTURE

2.2.1 **Basic Data:** The field survey was designed to determine and record these house characteristics:

1. Age
2. Style
3. Type
4. Moisture
5. General Level of Wall Insulation
6. Completion of Insulation
7. Air Leaks
8. Gable End Insulation
9. Basement Insulation
10. Attic Insulation

Through the use of the basic groupings, a computer useable data base format was developed to allow convenient data input and data management. To accomodate repetitive blocks of data, an input program was developed to allow rapid data entry and close verification. Then, two processes were used to check input data against the original raw data: 1. On-line error checking routines flagged any data that appeared suspect (such as a "post-'76 housing unit with no insulation") for further manual checking. 2. The complete data base printouts were randomly checked against the raw data tables, always checking at least one third of the data.

The Québec (Montréal) survey data revealed a common occurrence of 3-storey units. Since the program had no such category, these units have been recorded as 2½ storey units in the data base.

2.2.2 Analysis Program

The analysis program included all survey observations and yielded a full set of data correlations. It kept track of the total numbers of observations made, including houses with ambiguous or masked components. The program permitted analysis of any one correlation by any region. To reduce computer interface time, a "driving" routine was inserted into the basic data analysis package to allow "one shot" runs of the 23 listed correlations for each region.

In addition, the analysis package allowed for the setting of flags around "surprising" data to facilitate further verification and follow-up work. A list of the house codes and related "flag" descriptions can be produced for any regional data set.

3.0 REGIONAL FINDINGS

The seven thermographers surveyed the front and one end of each of 13,788 low-rise dwelling units across Canada. Thirteen characteristics were recorded and assessed on each, thus amassing more than 179,000 findings to form a picture of the housing stock in its present condition.

The findings have been tabulated first as Data Correlation Tables, which are voluminous and hence are presented under separate cover. The summary findings are presented here in two forms:

- example displays of thermograms and photographs judged to be:
  a) typical of the housing in each region
  b) representative of particular "problem cases".
- data summary tables.

Users are cautioned that all tabulations present the data "as found", with no attempt to normalise or rebalance the age groups to represent the CMA's actual pattern of housing more correctly. Each age group is probably well surveyed in itself but the overall inferences for each CMA should not be taken too literally without first normalizing the age patterns. This and other important limitations are set out in Section 4. FIRST ANALYSIS OF FINDINGS.

3.1 THERMOGRAPHY/PHOTOGRAPHY COVERAGE: TYPICAL EXAMPLES

The next 16 pages exhibit thermograms and photographs of houses judged to be typical of the existing stock and conditions in each region. Because of space limitations only one face is shown thermographically, although the front and one end, where viewable, were scanned, recorded and assessed for each house.

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3. 1 Examples of Regional Housing Units

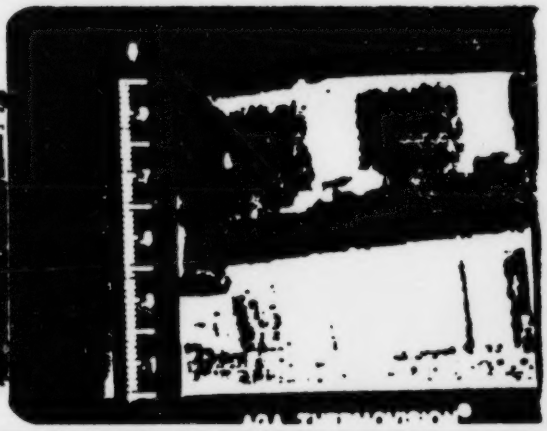

Image # 1.0 House # S 1277	Wall Insul: Med/Full Air Leakage: M
Location: St. John's Age: Pre '45	Comments: Note air leakage pattern at
Style: 2-storey Type: Single Det.	base of dormer windows

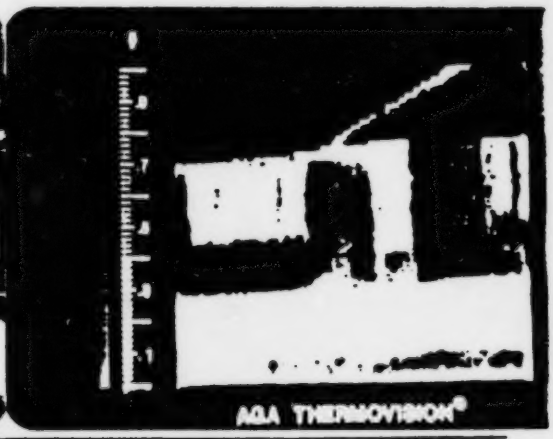

Image # 2.0 House #S 1244	Wall Insul: Full Air Leakage:
Location: St. John's Age: 45-50	Comments: Uninsulated basement,
Style: 1-storey Type: Single Det.	crossbracing evident.

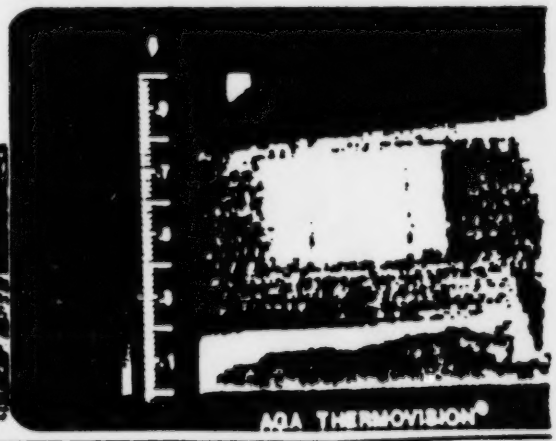

Image # 3.0 House #S 870	Wall Insul: Med Air Leakage: M
Location: St. John's Age: 51-60	Comments: Uniform insulation placeme
Style: 1-storey Type: Single Det.	uninsulated basement.

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3. 1 Examples of Regional Housing Units

Image # 4.0 **House #** S 945
Location: St. John's **Age:** 51-60
Style: 1-storey **Type:** Single Det.

Wall Insul: Full **Air Leakage:** Med
Comments: Uniform insulation placement, uninsulated basement.

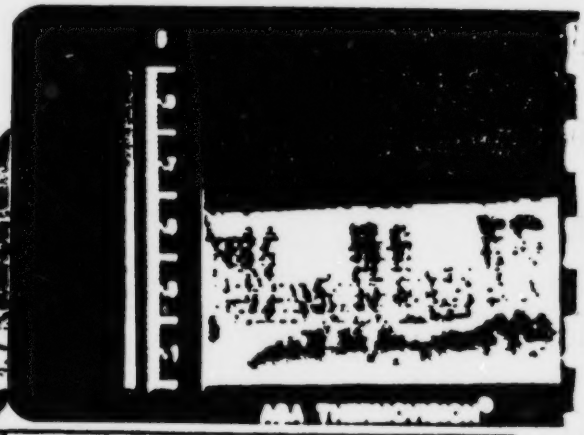


Image # 5.0 **House #** S 522
Location: St. John's **Age:** 61-75
Style: 1-storey **Type:** Single Det.

Wall Insul: Med **Air Leakage:** ___
Comments: Flueless home, uniform wall insulation.

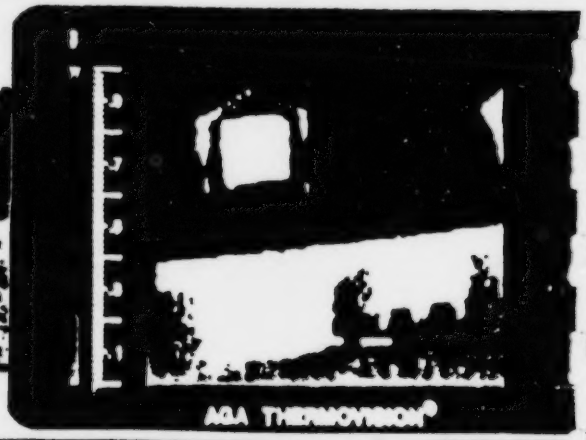


Image # 6.0 **House #** S 559
Location: St. John's **Age:** 76-82
Style: 1½-storey **Type:** Single Det.

Wall Insul: Full **Air Leakage:** Me
Comments: Note air leakage at soffits and around dormers.

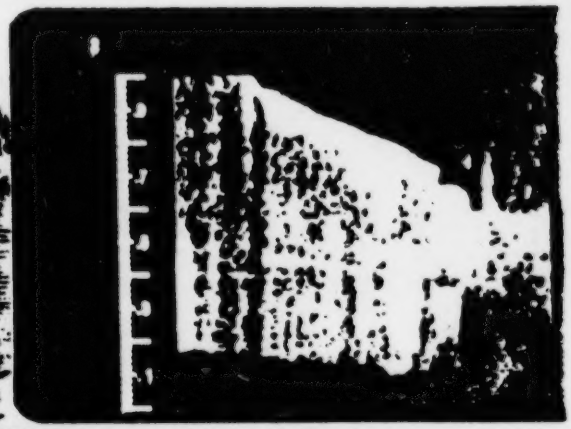
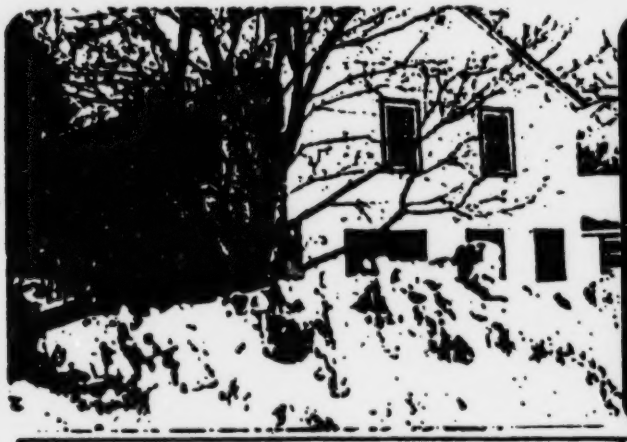


Image # 7.0 **House #** N 313
Location: Fredericton **Age:** Pre 45
Style: 2½-storey **Type:** Single Det.

Wall Insul: Med **Air Leakage:** Me
Comments: Uniform insulation placement in walls.



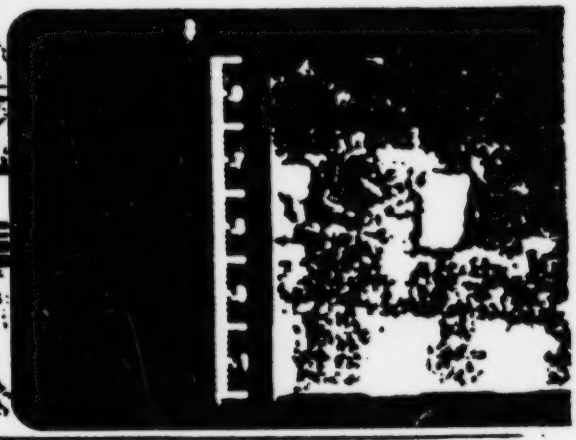


Image # 8.0 **House #** N 898
Location: Fredericton **Age:** Pre 45
Style: 2-storey **Type:** Single Det.

Wall Insul: Med **Air Leakage**
Comments: Minor insulation void[illegible] with air leakage or m[illegible]

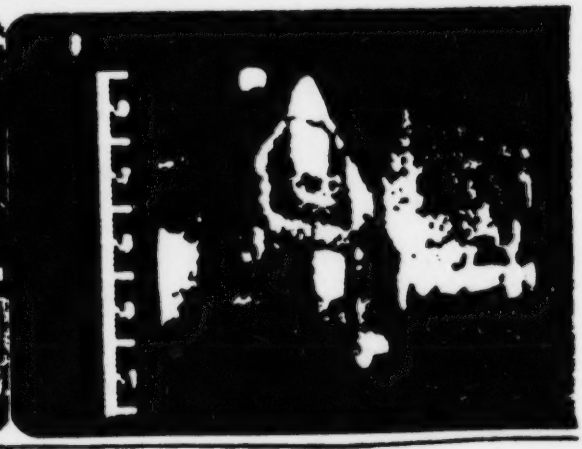


Image # 9.0 **House #** N 328
Location: Fredericton **Age:** 45-50
Style: 1½-storey **Type:** Single Det.

Wall Insul: Med **Air Leakage:** Med
Comments: Note: Heat loss from attic and framing details.

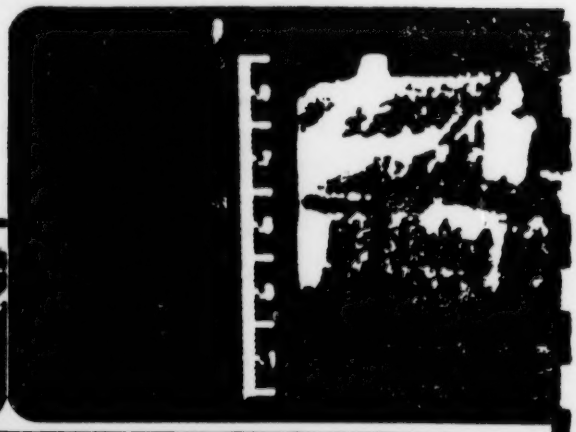


Image # 10.0 House # N 1298 Location: Fredericton Age: 51-60 Style: 1½-storey Type: Single Det.	Wall Insul: Med Air Leakage: Me Comments: Kneewall/roof area depicting heat loss.

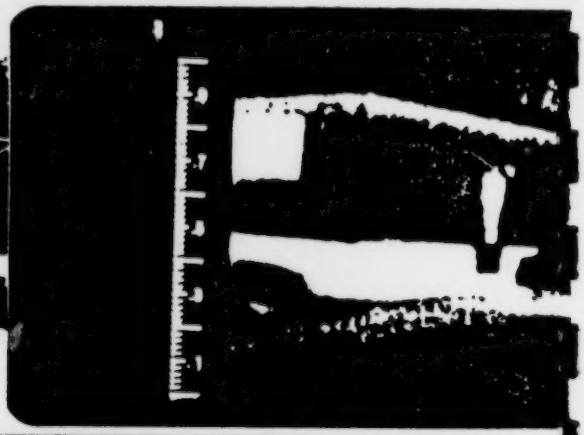
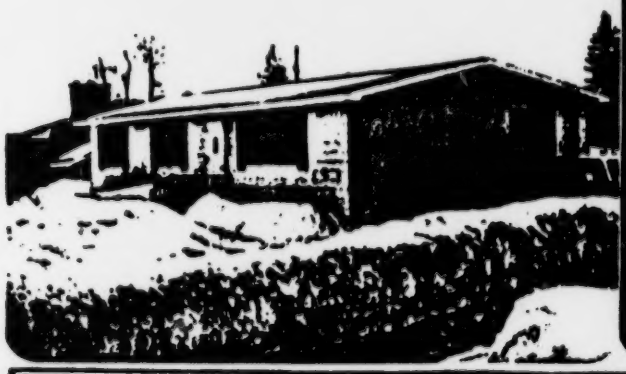


Image # 11.0 House # N 1449 Location: Moncton Age: 61-75 Style: 1-storey Type: Single Det.	Wall Insul: Full Air Leakage Comments: Uniform wall insulation uninsulated basement



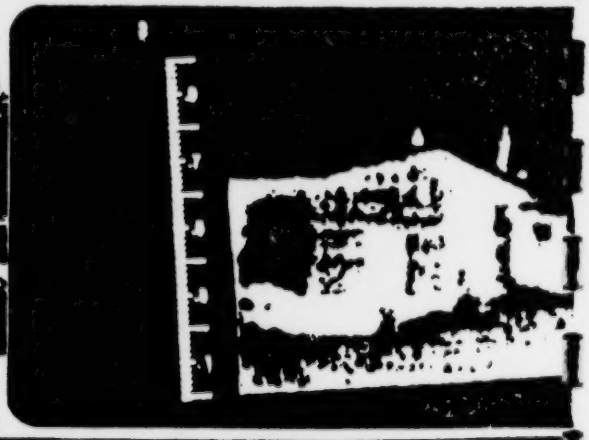


Image # 12.0 House # N 985 Location: Fredericton Age: 76-82 Style: 1-storey Type: Single Det.	Wall Insul: Full Air Leakage: Lo Comments: Poor insulation placement bel side window-uninsulated bas

Scanada 3. 1 Examples of Regional Housing Units

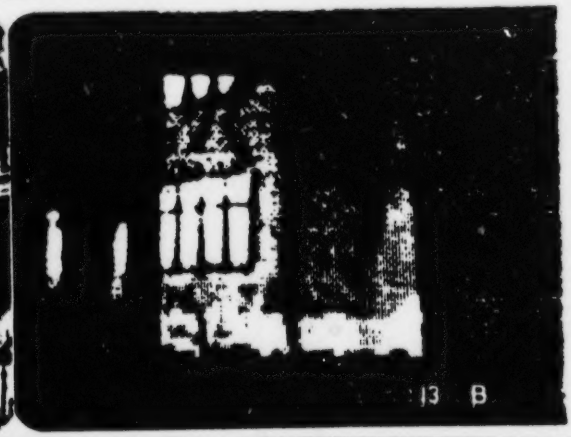


Image # 13.0 House # 13 B 1	Wall Insul: Med Air Leakage: Lo
Location: Montreal Age: Pre 45	Comments: Uniform wall temperature
Style: 2-storey Type: Quadplex	Uninsulated basement-Note br

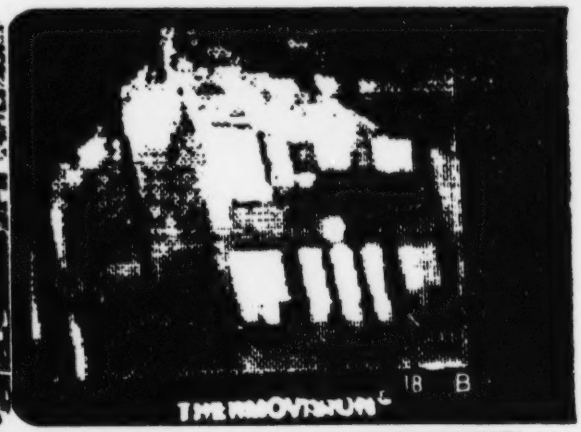


Image # 14.0 House # 18 B 1	Wall Insul: Med Air Leakage
Location: Montreal Age: Pre 45	Comments: Note heat loss pattern
Style: 3-storey Type: Triplex	attic and floor header

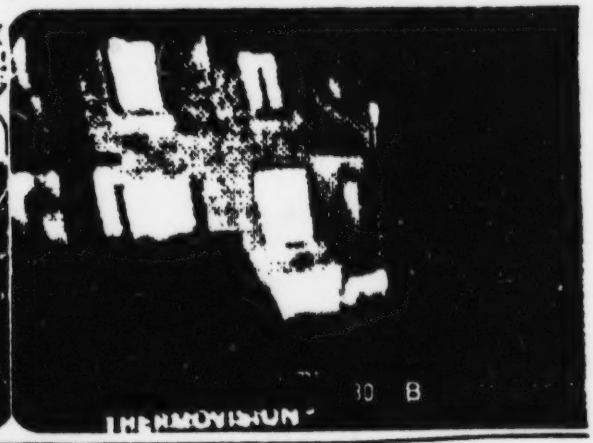


Image # 15.0 House # 30 B 1	Wall Insul: Med Air Leakage: Med
Location: Montreal Age: 45-50	Comments: Air leakage, possible moistu
Style: 2-storey Type: Semi-det.	below sills.

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3. 1 Examples of Regional Housing Units

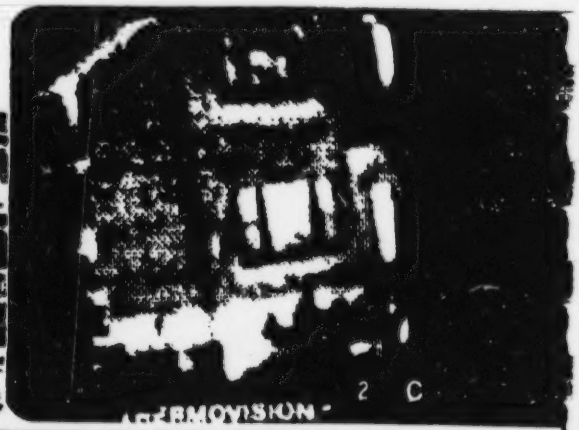


Image # 16.0 House # 2 C 1 Location: Montreal Age: 51-60 Style: 2-storey Type: Quadplex	Wall Insul: Med Air Leakage: Me Comments: Air leakage, possible moist below sills.

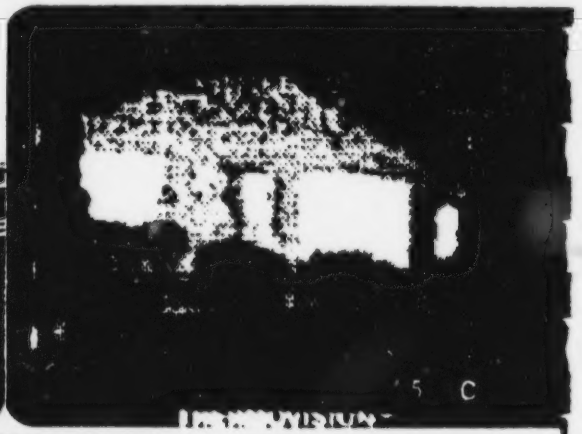
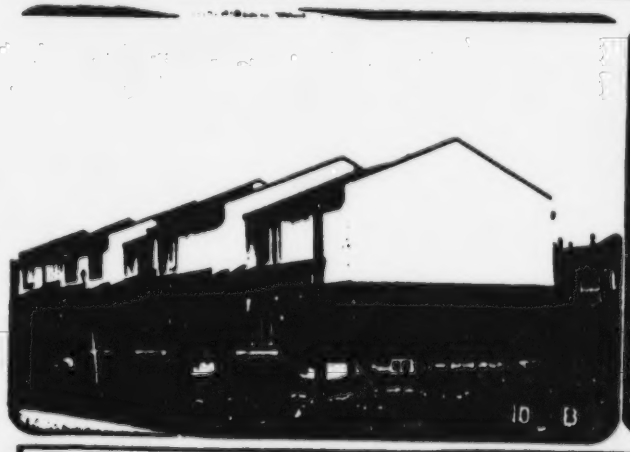


Image # 17.0 House # 5 C 1 Location: Montreal Age: 61-75 Style: 1-storey Type: Single Det.	Wall Insul: Med Air Leakage: Comments: Minimal air leaks, unit wall insulation



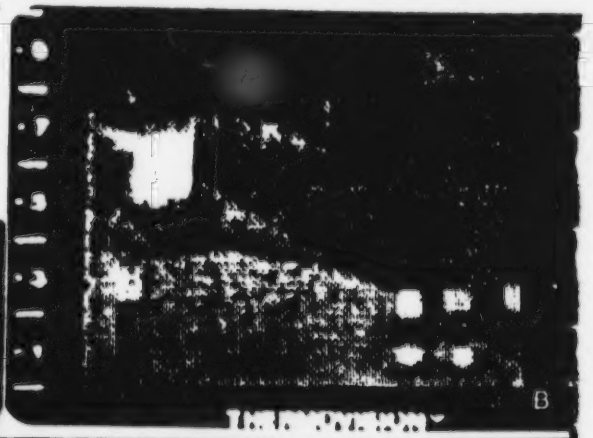


Image # 18.0 House # 10 B 1 Location: Montreal Age: 76-82 Style: 2-storey Type: Row Town	Wall Insul: Full Air Leakage: Lo Comments: 1st/2nd floor temperature di due to emissivity differenc

Scanada 3. 1 Examples of Regional Housing Units

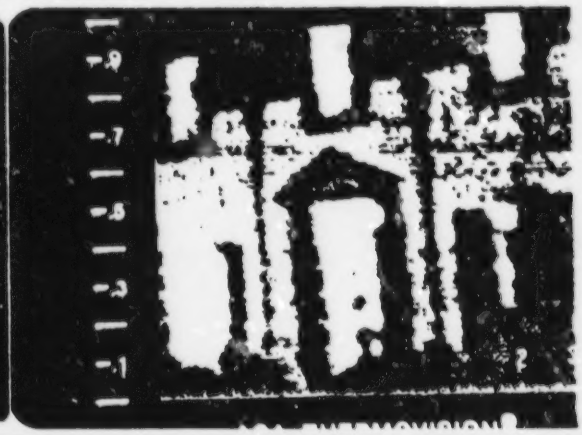


Image # 19.0 House # T 632	Wall Insul: Nil Air Leakage: Med
Location: Toronto Age: Pre 45	Comments: Uninsulated solid masonry wal
Style: 2½-storey Type: Single Det.	

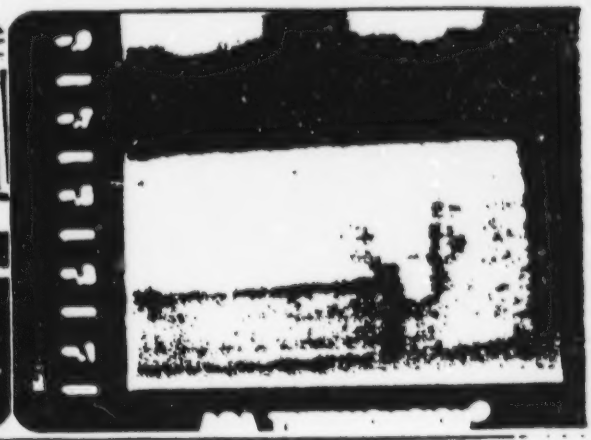


Image # 20.0 House # T 860	Wall Insul: Nil Air Leakage:
Location: Toronto Age: Pre 45	Comments: Uninsulated solid ma
Style: 2-storey Type: Single Det.	

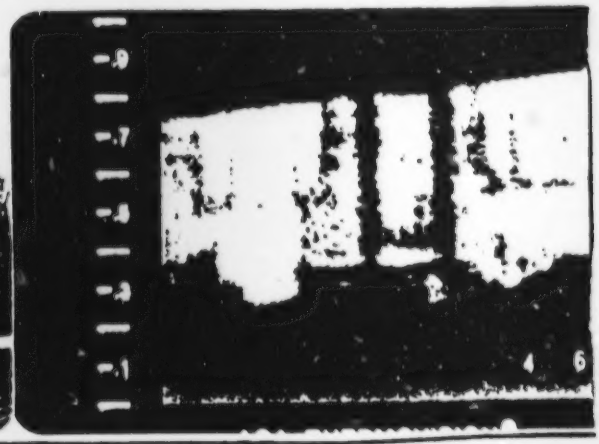


Image # 21.0 House # T 464	Wall Insul: Nil Air Leakage: Med
Location: Toronto Age: 45-50	Comments: Uninsulated solid masonry wal
Style: 1-storey Type: Single Det.	

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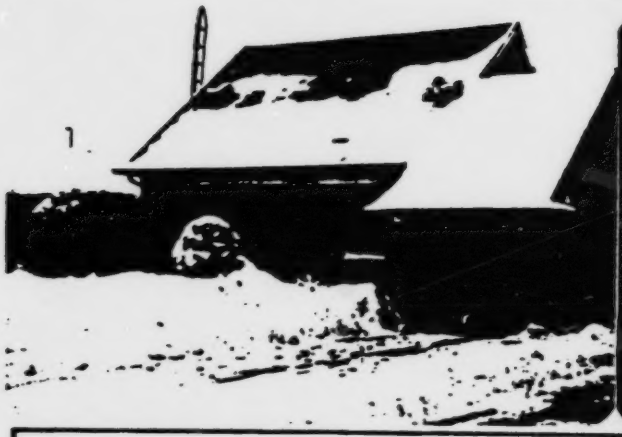
3. 1 Examples of Regional Housing Units



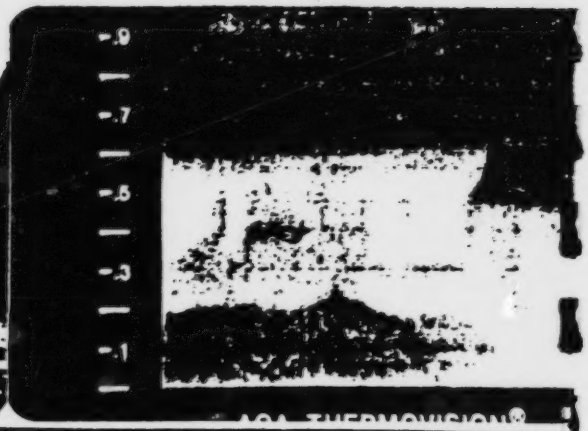


Image # 22.0 House # T 179	Wall Insul: Nil Air Leakage: Med
Location: Toronto Age: 51-60	Comments: Uninsulated solid masonry wa
Style: 1½-storey Type: Single Det.	

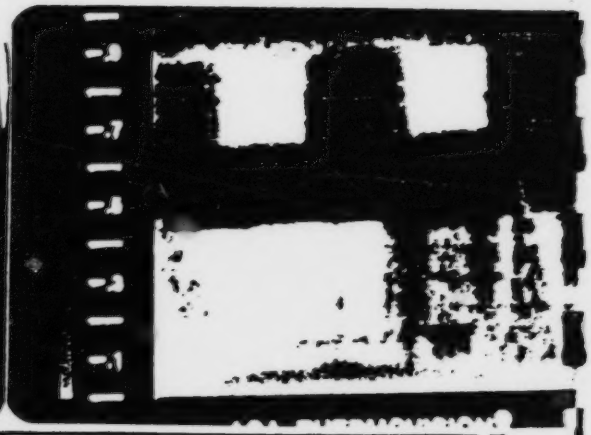


Image # 23.0 House # T 52	Wall Insul: Med Air Leakage.
Location: Toronto Age: 61-75	Comments: 2nd floor uniformly heat
Style: 2-storey Type: Semi-det.	

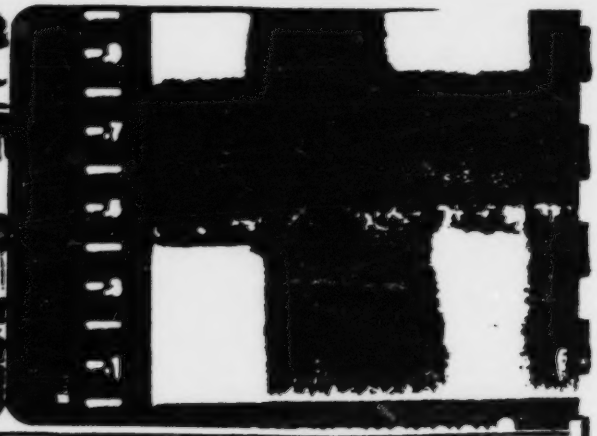


Image # 24.0 House # O 563	Wall Insul: Full Air Leakage: Lo
Location: Ottawa Age: 76-82	Comments: Heat loss from 1st/2nd floor
Style: 2-storey Type: Row/Town	header area

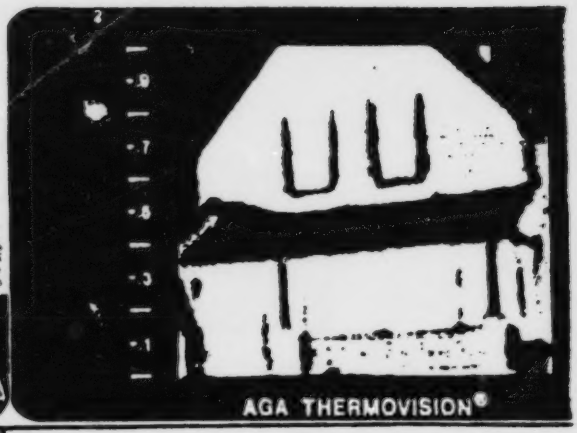


Image # 25.0 House # L 464	Wall Insul: Nil Air Leakage: Hig
Location: London Age: Pre 45	Comments: Similar wall/window temperatu
Style: 1½-storey Type: Single Det.	Uninsulated, Brick veneer

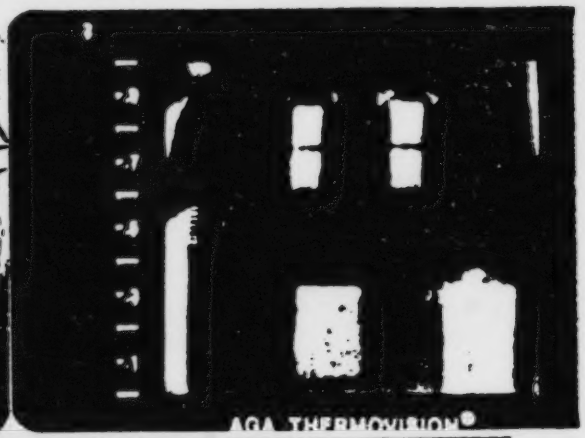


Image # 26.0 House # L 464	Wall Insul: Full Air Leakage
Location: London Age: Pre 45	Comments: Some air leakage around
Style: 2-storey Type: Single Det.	window frames

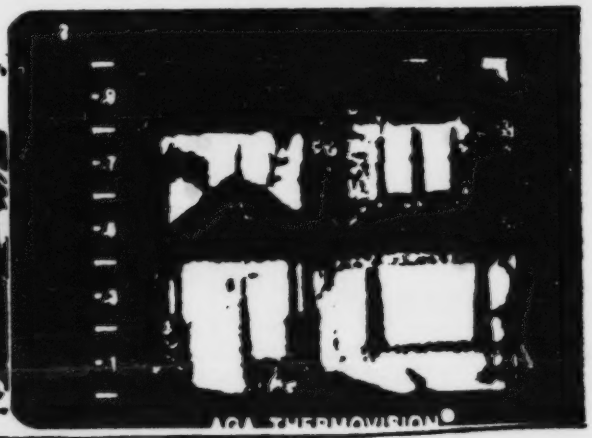


Image # 27.0 House # L 1123	Wall Insul: Nil Air Leakage: Med
Location: London Age: 45-50	Comments: Note air leakage at
Style: 2-storey Type: Single Det.	building jog.

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3. 1 Examples of Regional Housing Units

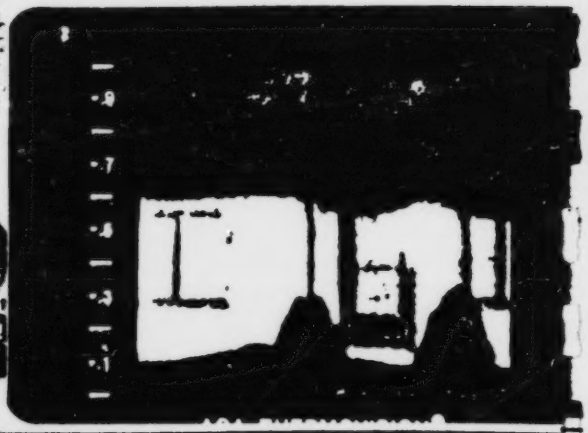
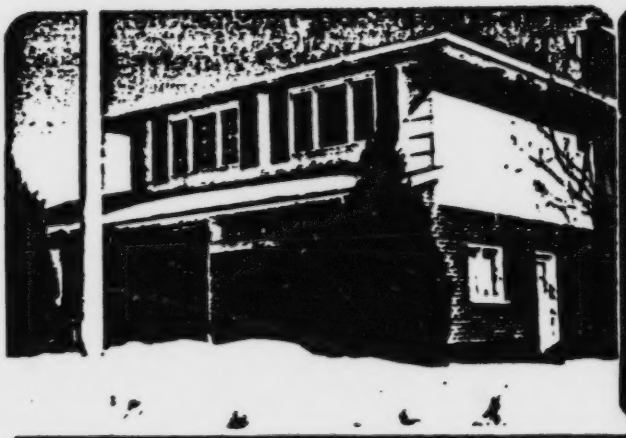


Image # 28.0 House # L 1316	Wall Insul: Nil Air Leakage: Med
Location: London Age: 51-60	Comments: Uninsulated - Note warm wall
Style: 1½-storey Type: Single Det.	temperature



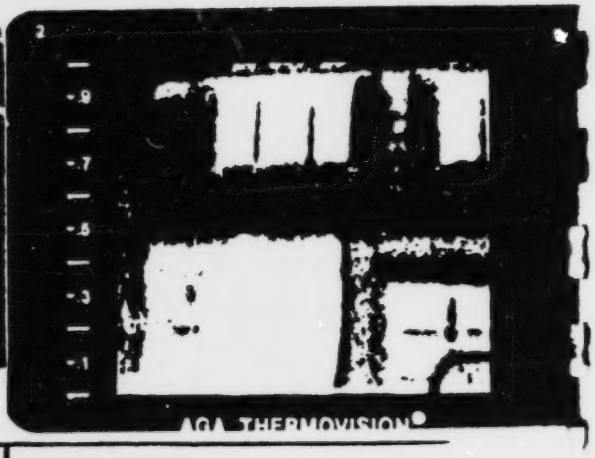
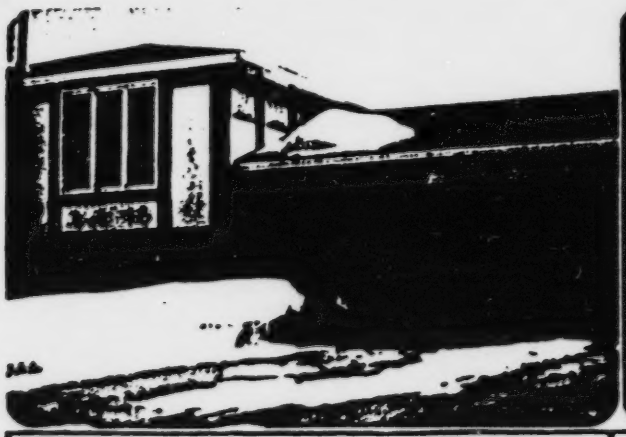


Image # 29.0 House # L 173	Wall Insul: Med Air Leakage:
Location: London Age: 61-75	Comments: Thermal bridge visible
Style: Split-level Type: Single Det.	through 2nd floor framing



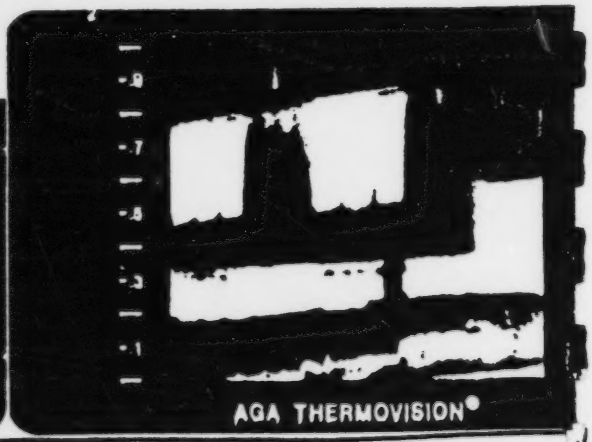


Image # 30.0 House # L 28	Wall Insul: Full Air Leakage: Med
Location: London Age: 76-82	Comments: Framing pattern clearly
Style: Split-level Type: Single Det.	evident. Insulation well pl

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3. 1 Examples of Regional Housing Units

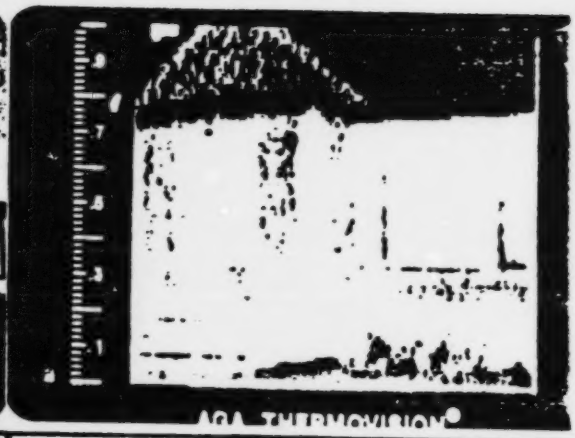

Image # 31.0 House # W 342 Location: Winnipeg Age: Pre 45 Style: 1-storey Type: Single Det.	Wall Insul: Nil Air Leakage: Me Comments: Uninsulated stucco/frame home.

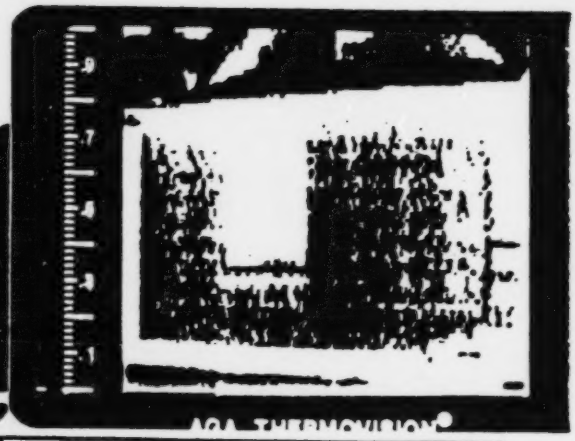

Image # 32.0 House # W 581 Location: Winnipeg Age: Pre 45 Style: 1½-storey Type: Single Det.	Wall Insul: Med Air Leakage. Comments: Wall framing evident. Foundation heat loss.

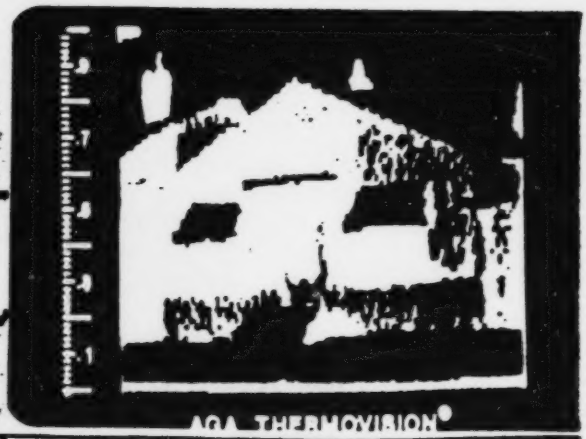

Image # 33.0 House # W 1445 Location: Winnipeg Age: 45-50 Style: 1-storey Type: Single Det.	Wall Insul: Nil Air Leakage: Med Comments: Uninsulated stucco/frame home

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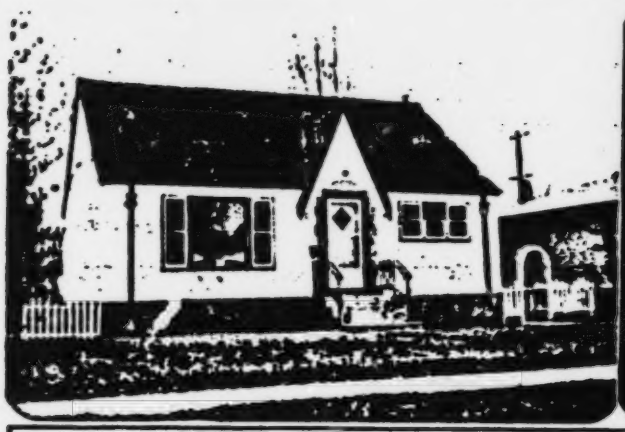
3. 1 Examples of Regional Housing Units



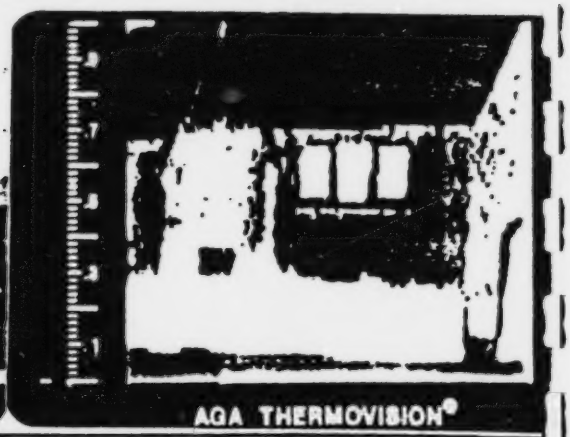


Image # 34.0 House # W 1723 Location: Winnipeg Age: 51-60 Style: 1-storey Type: Single Det.	Wall Insul: Med Air Leakage: Me Comments: Insulation well placed Basement uninsulated

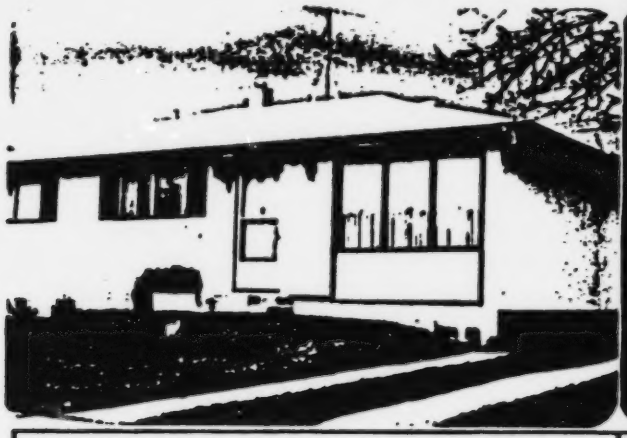
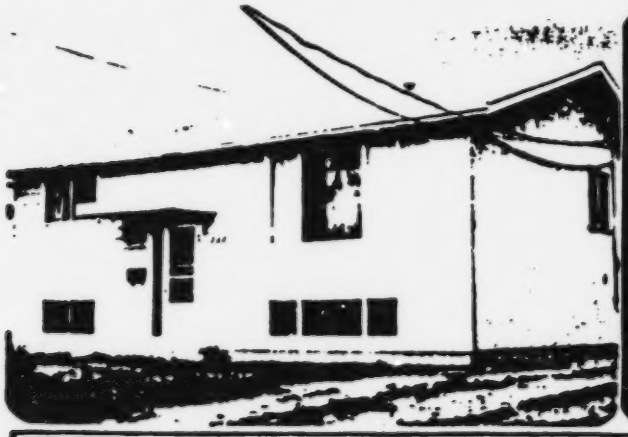


Image # 35.0 House # W 814 Location: Winnipeg Age: 61-75 Style: 1-storey Type: Single Det.	Wall Insul: Med Air Leakage Comments: Uniform wall insulat Basement uninsulated



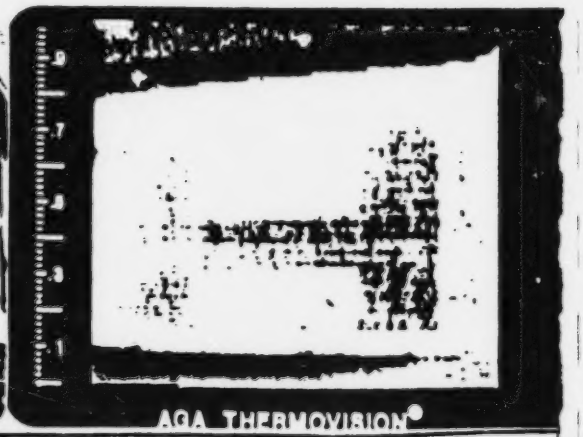


Image # 36.0 House # W 851 Location: Winnipeg Age: 61-75 Style: Raised Bung. Type: Single Det.	Wall Insul: Med Air Leakage: Lo Comments: Note: Heat loss from 1st floor header and founda

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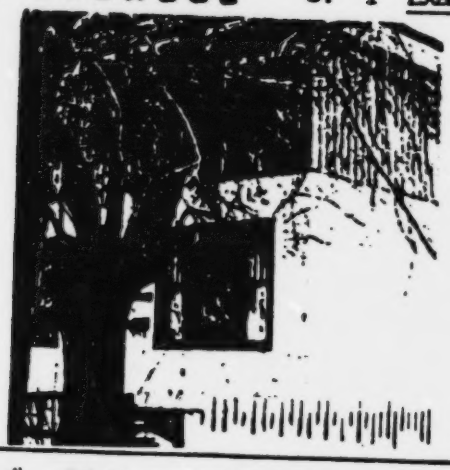
3. 1 Examples of Regional Housing Units



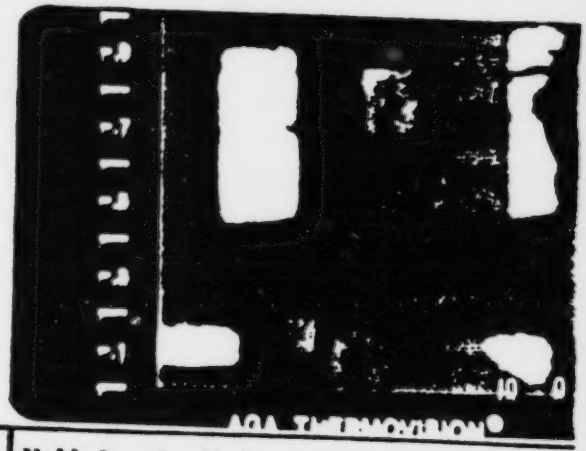


Image # 37.0 House # E 667 Location: Edmonton Age: Pre 45 Style: 1½-storey Type: Single Det.	Wall Insul: Med Air Leakage: Med Comments: Single glazing, storm door Uniform wall insulation

Image # 38.0 House # E 773 Location: Edmonton Age: Pre 45 Style: 1-storey Type: Single Det.	Wall Insul: Med Air Leakage Comments: Single glazed picture Surface mositure in st

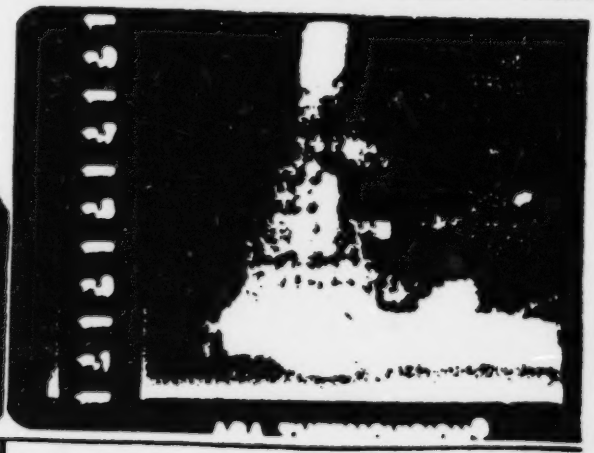


Image # 39.0 House # E 158 Location: Edmonton Age: 45-50 Style: 1½-storey Type: Single Det.	Wall Insul: Med Air Leakage: Med Comments: Uniform wall insulation Uninsulated basement

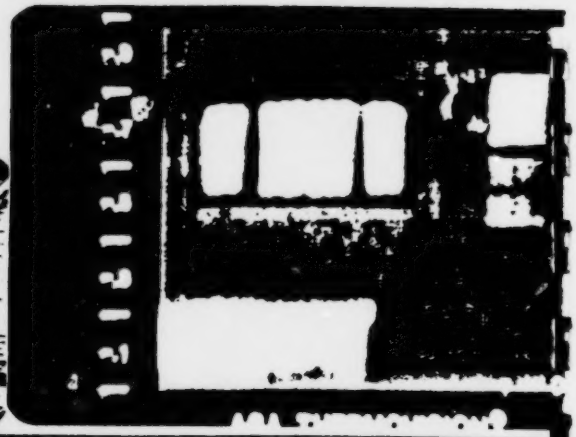


Image # 40.0 House # E 592 Location: Edmonton Age: 45-50 Style: 1-storey Type: Single Det.	Wall Insul: Med Air Leakage: Me Comments: Uniform wall temperature, St Door, Basement uninsulated

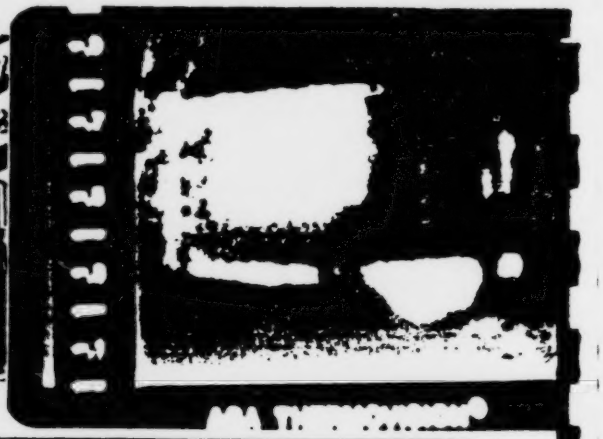


Image # 41.0 House # E 181 Location: Edmonton Age: 51-60 Style: 1-storey Type: Single Det.	Wall Insul: Full Air Leak Comments: Air leakage at buil Probable single glaz

Image # 42.0 House # C 620 Location: Calgary Age: Pre 45 Style: 1-storey Type: Single Det.	Wall Insul: Nil Air Leakage: M Comments: Wall framing evident Single glazed windows

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3. 1 Examples of Regional Housing Units

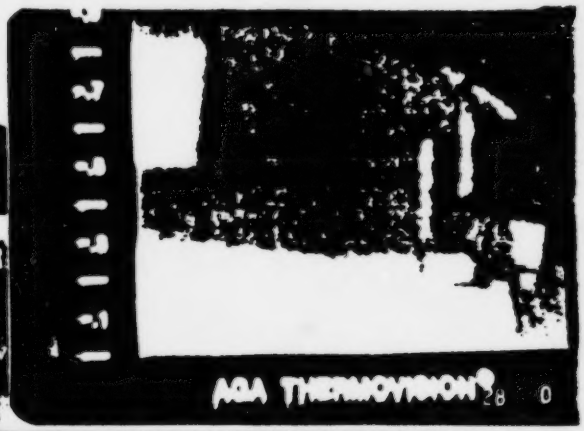
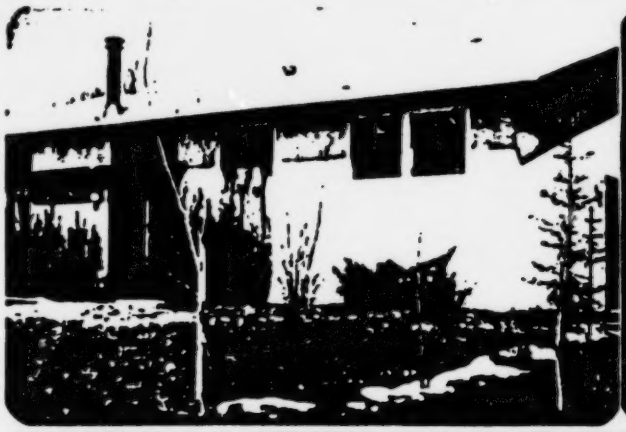


Image # 43.0 **House #** C 581	**Wall Insul:** Med **Air Leakage:** Med
Location: Calgary **Age:** 51-60	**Comments:** Basement uninsualted
Style: 1-storey **Type:** Single Det.	



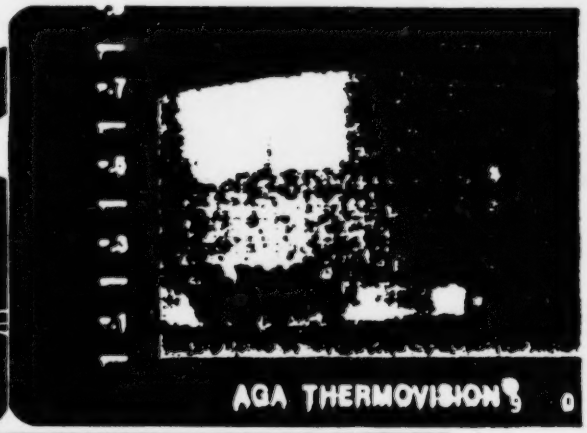


Image # 44.0 **House #** C 121	**Wall Insul:** Med **Air Leakage:**
Location: Calgary **Age:** 61-75	**Comments:** Uniform wall insulation
Style: 1-storey **Type:** Single Det.	Foundation insulated

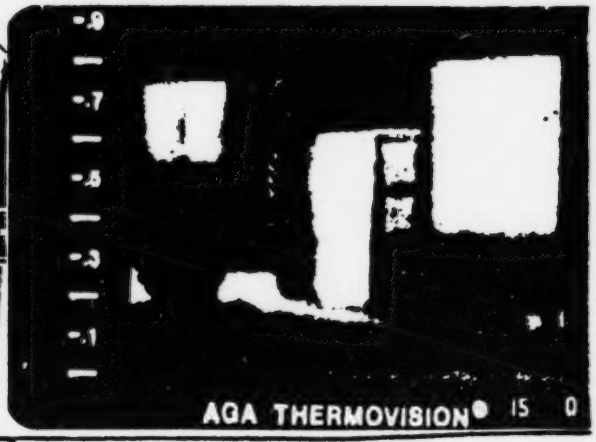
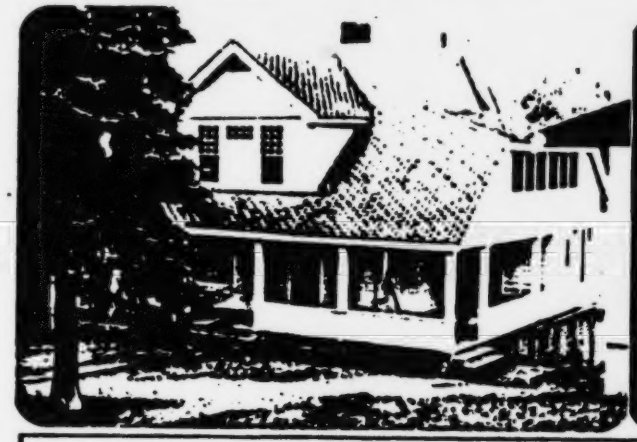


Image # 45.0 **House #** C 241	**Wall Insul:** Full **Air Leakage:** Med
Location: Calgary **Age:** 61-75	**Comments:** Uniform wall insulation
Style: Raised Bung. **Type:** Single Det.	

3. 1 Examples of Regional Housing Units

Image # 46.0 House # C 501 Location: Calgary Age: 76-82 Style: Raised Bung. Type: Single Det.	Wall Insul: Full Air Leakage: Lo Comments: New infill, foundation heat loss evident



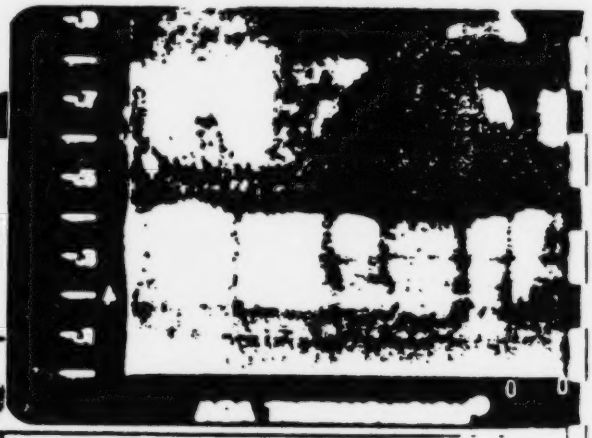


Image # 47.0 House # V 51 Location: Nelson Age: Pre 45 Style: 1½-storey Type: Single Det.	Wall Insul: Nil Air Leak Comments: Note single glazed

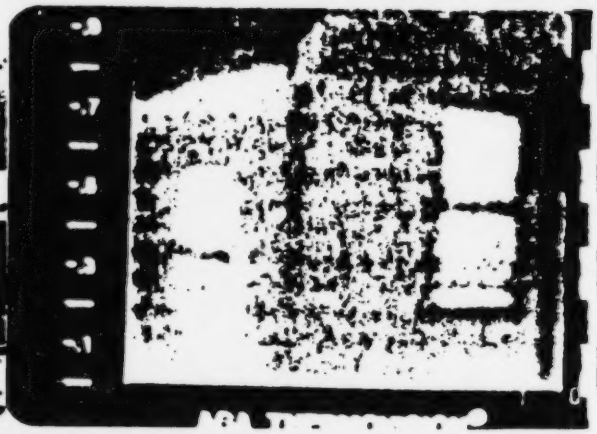


Image # 48.0 House # V 61 Location: Nelson Age: Pre 45 Style: 1-storey Type: Single Det.	Wall Insul: Nil Air Leakage: Me Comments: Uninsulated stucco/frame home

3.2 THERMOGRAPHY/PHOTOGRAPHY COVERAGE: "THERMALLY UNFIT" EXAMPLES

Some example coverage of such cases is presented on the next three pages, representing the challenges (and opportunities) peculiar to each region.. .Included are:

- houses plagued with excessive moisture within the insulated wall structure, especially in Newfoundland;
- uninsulated solid masonry houses - difficult to retrofit with insulation - especially common in Toronto;
- examples of the surprisingly common incidence of completely uninsulated wood frame houses in Winnipeg;
- Calgary/Edmonton examples with single glazed windows and (common in all regions) completely uninsulated basements.

These are discussed in Section 4, FIRST ANALYSIS OF FINDINGS. The moisture phenomenon was found to some extent across Canada, and is given special consideration and analysis in a separate paper.

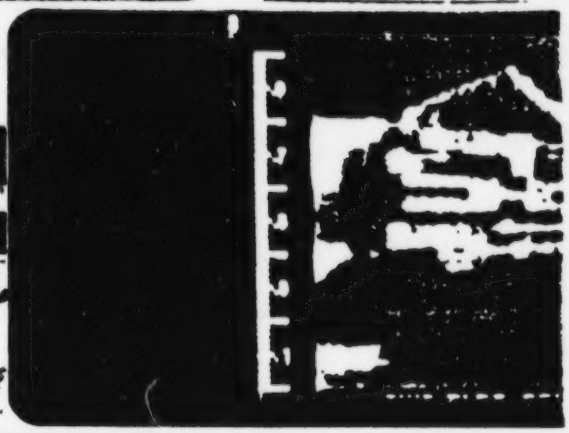
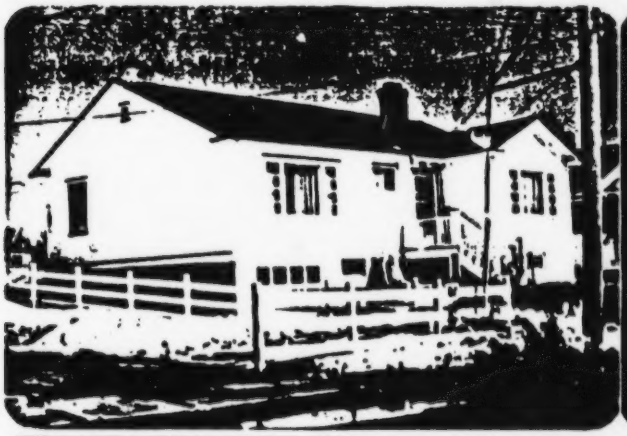


Image # 49.0 House # N 1018
Location: Fredericton Age: 61-75
Style: Raised Bung. Type: Single Det.

Wall Insul: Full Air Leakage: Lo
Comments: Moisture



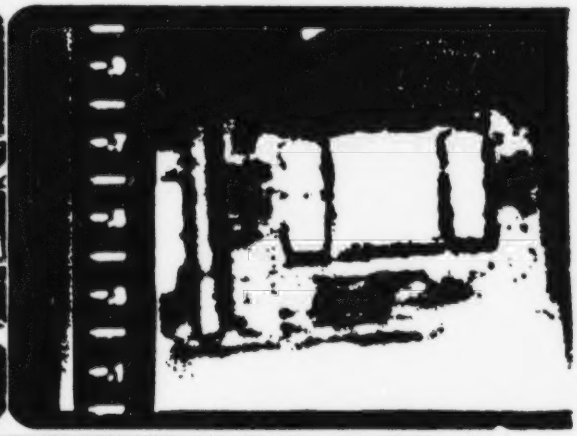


Image # 50.0 House # S 1196
Location: St. John's Age: Pre 45
Style: 1-storey Type: Single Det.

Wall Insul: Med Air Le...,
Comments: Moisture

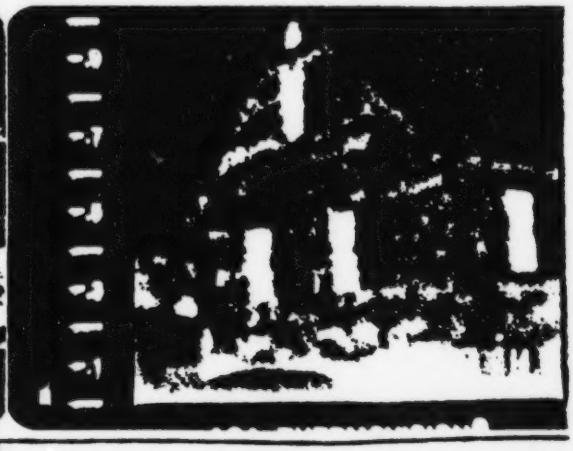


Image # 51.0 House # S 1214
Location: St. John's Age: Pre 45
Style: 1½-storey Type: Single Det.

Wall Insul: Med Air Leakage: Me
Comments: Uneven patterns of moisture

Scanada 3.2 THERMALLY UNFIT - UNINSULATED HOMES

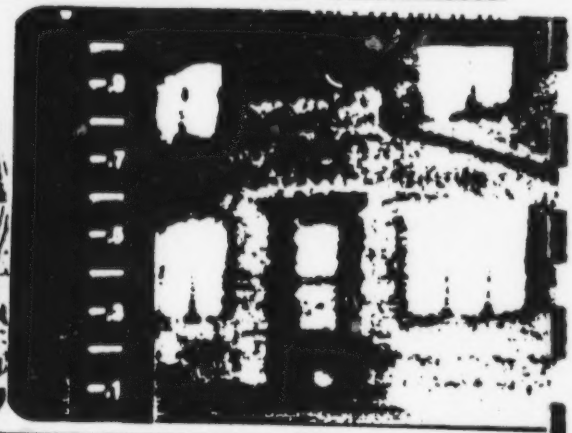


Image # 52.0 House # T 456
Location: Toronto Age: 45-50
Style: 1½-storey Type: Single Det.

Wall Insul: Nil Air Leakage: Me
Comments: Uninsulated solid masonry w

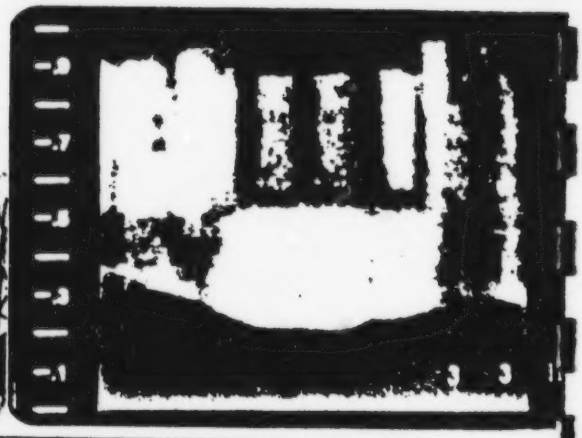


Image # 53.0 House # T 1153
Location: Toronto Age: 45-50
Style: 1-storey Type: Single Det.

Wall Insul: Nil Air Leak
Comments: Uninsulated solid m
may have hydronic radi

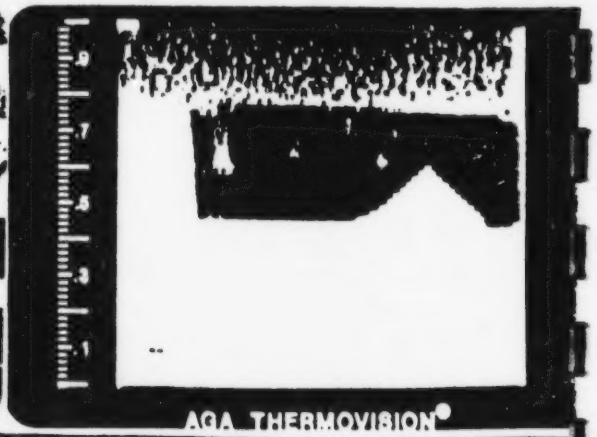
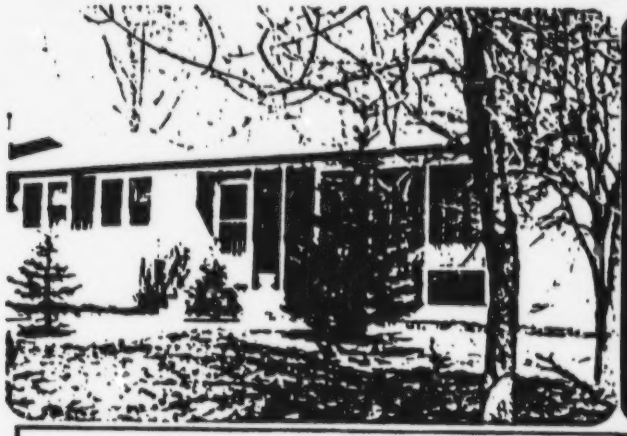


Image # 54.0 House # W 155
Location: Winnipeg Age: Pre 45
Style: 1½-storey Type: Single Det.

Wall Insul: Nil Air Leakage: Hig
Comments: Uninsulated wood frame walls
stucco exterior

Scanada 3.2 THERMALLY UNFIT - UNINSULATED BASEME



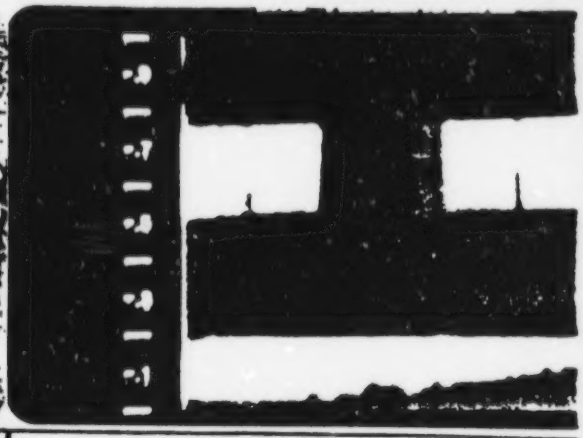


Image # 55.0 House # C 115
Location: Calgary Age: 61-75
Style: 1-storey Type: Single Det.

Wall Insul: Full Air Leakage: Lo
Comments: Uninsulated basement

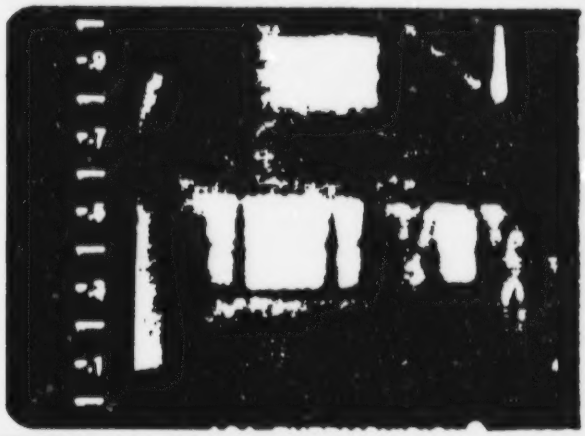


Image # 56.0 House # E 268
Location: Edmonton Age: 45-50
Style: 1½-storey Type: Single Det.

Wall Insul: Med Air Le...
Comments: Poor placement of
likely due to framing

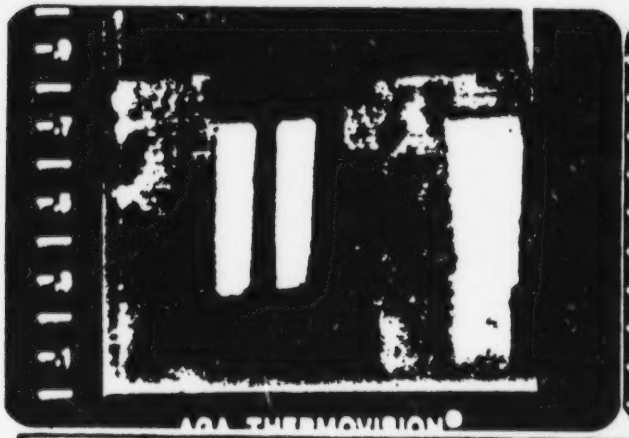


Image # 57.0 House # ---
Location: Edmonton Age: Pre 45
Style: 2-storey Type: Single Det.

Wall Insul: Med Air Leakage: Med
Comments: Both images represent
insulation voids - poor place

3.3 DATA SUMMARY TABLES

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DATA SUMMARY TABLES

Location: ST. JOHN'S

HOUSING STOCK CHARACTERISTICS BY AGE & CITY

AGE GROUP & (% of Total)	STYLE						TYPE					MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE			INSULATION IN:	
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex		Nil	Med	Full	Settled	Poor Placement	Voids	Uniform	Low	Med	High	Basement	Attic
Pre 1945 15 %																								
%	10	9	69		1	12	60		25	15		19	21	47	32			4	96	2	66	32	3	
1945-1950 7 %																								
%	21	4	30			45	100					34	7	46	48			5	95	4	61	35	1	
1951-1960 19 %																								
%	60	15	23		2	1	94			6		16		31	69		2	7	91	21	60	19	10	
1961-1975 40 %																								
%	43		28		3	26	72		25	3	1	33	4	22	74			2	98	8	60	32	62	
1976-1982 19 %																								
%	14		20		22	44	82	2	7		9	22			100			2	98	9	50	41	79	
TOTAL 100%	No. of Homes Surveyed: 1314						1315					1323	1255			1323				1308			1104	
%	34	4	32		6	24	78		15	4	2	26	5	25	70		1	4	96	10	59	31	41	

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DATA SUMMARY TABLES

Location: FREDERICTON/MONCTON

AGE GROUP & (% of Total)	STYLE: 1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	TYPE: Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.: Nil	Mod	Full	COMPLETION OF INSUL.: Settled	Poor Placement	Voids	Uniform	AIR LEAKAGE: Low	Mod	High	DEGLATION IN: Basement *	Attic
Pre 1945 26 %																								
%	4	27	28	42			84	14		2		15	10	88	3		11	7	82	46	46	7	2	
1945-1950 16 %																								
%	10	58	28	5			96	3		2		5	8	88	3		7	6	86	68	29	3		
1951-1960 15 %																								
%	65	26	4	1	3		99					2	1	75	24		4	2	93	85	15	1		
1961-1975 31 %																								
%	64	1	9		7	19	97	3				1	0	37	63		5	2	93	74	25	2	13	
1976-1982 12 %																								
%	38		10		9	43	94	5				0	0	6	94		6	3	91	69	30	1	65	
TOTAL NOR	No. of Homes Surveyed: 1988						1980					1998	1989			1998				1984			379	
%	37	20	16	12	4	11	93	5	0	1	0	5	4	60	36		7	4	89	67	30	3	18	

*Too few basements visible because of snow drifts

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DATA SUMMARY TABLES

Location: MONTREAL

AGE GROUP & (% of Total)	STYLE: 1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	TYPE: Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.: Nil	Med	Full	COMPLETION OF INSUL.: Settled	Poor Placement	Voids	Uniform	AIR LEAKAGE: Low	Med	High	INSULATION IN: Basement*	Attic
Pre 1945 34 %																								
%			33	67				2	98				94	5	1		1	1	98	71	16	13	50	
1945-1950 10 %												1	5	33**	62**	27	1	1	71	74	14	12	31	
%			97	3			6	94																
1951-1960 22 %																		2	98	63	10	27	2	
%	2	4	64	31			11	13	60	4	12	25	82	17	1									
1961-1975 24 %													2	95	3				100	91	8	1		
%	31		59	1	6	3	36	3	3	11	47													
1976-1982 10 %															100				100	22	78			
%			99	2			1	19	74	1	7												336	
TOTAL HOME	No. of Homes Surveyed: 2003						1982					2008	2000			2008				1977				
%	8	1	59	30	1	1	12	16	54	4	15	6	50	32	17	3	1	1	96	69	19	12	9	

primarily plank-frame

**highly suspect-fooled by brick veneer?

apparentky transient wetting of brick under window sills

*Too few basements visible because of snow drifts

Scanada

DATA SUMMARY TABLES

Location: HULL

AGE GROUP & (% of Total)	STYLE						TYPE					MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE			INSULATION IN:		
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex		Nil	Med	Full	Settled	Poor Placement	Voids	Uniform	Low	Med	High	Basement	Attic	
Pre 1945 27 %																									
%	24	20	54	1		1	94	6				32	2	55	43				100	47	51	2			
1945-1950 15 %																									
%	51	28	21				100					14	2	79	19				100	61	29	11	4		
1951-1960 8 %																									
%	25	61	14				100					7		25	75				100	75	25				
1961-1975 43 %																									
%	65	1	27	1		7	94	6				1		36	64				100	60	40		61		
1976-1982 7 %																									
%	26		56			19	56		44			4			100				100	93	7		100		
TOTAL HOME	No. of Homes Surveyed: 374						362					374	373			374				368			104		
%	46	14	35	1		5	92	4	3			12	1	44	55				100	60	38	2	44		

Seamada

DATA SUMMARY TABLES

Location: OTTAWA

AGE GROUP & (% of Total)	STYLE: 1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	TYPE: Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.: Nil	Med	Full	COMPLETION OF INSUL.: Settled	Poor Placement	Voids	Uniform	AIR LEAKAGE: Low	Med	High	INSULATION IN: Basement	Attic
Pre 1945 41 %																								
%		2	9	89			98			2			45	55					100	8	45	47		
1945-1950 0 %																								
%																								
1951-1960 0 %																								
%																								
1961-1975 50 %																								
%			100						100					99	1				100	56	43	1		
1976-1982 9 %																								
%			48	52					100					48	52				100	30	70			
TOTAL 100%	No. of Homes Surveyed: 254						254					254	253			254				253				
%		1	58	41			40		59	1		0	19	76	5				100	34	46	20		

IGNORE TOTALS: SURVEY NOT A CROSS SECTION

Scanada

DATA SUMMARY TABLES

Location: TORONTO

AGE GROUP & (% of Total)	STYLE: 1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	TYPE: Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.: Nil	Med	Full	COMPLETION OF INSUL.: Settled	Poor Placement	Voids	Uniform	AIR LEAKAGE: Low	Med	High	INSULATION IN: Basement	Attic
Pre 1945 40%																								
%	11	17	34	38			68	29	3				94	6					100	8	80	12	3	
1945-1950 10%																								
%	42	30	24		3	1	94	6					86	14					100	11	86	4	10	
1951-1960 16%																								
%	59	9	5		24	3	87	13				3	96	4					100	2	92	6	13	
1961-1975 24%																								
%	46	2	26		23	3	87	13					32	68				5	95	22	73	5	51	
1976-1982 10%																								
%	18		51	17	15		79	21					3	43	54				100	66	30	4	99	
TOTAL NOS.	No. of Homes Surveyed: 1697						1697					1704	1685			1704				1692			1124	
%	31	12	28	17	11	1	80	19	1			0	70	25	5			1	99	16	76	8	29	

primarily solid masonry

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DATA SUMMARY TABLES

Location: LONDON

AGE GROUP & (% of Total)	STYLE: 1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	TYPE: Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.: Nil	Med	Full	COMPLETION OF INSUL.: Settled	Poor Placement	Voids	Uniform	AIR LEAKAGE: Low	Med	High	DURATION IN: Basement*	Attic
Pre 1945 31%																								
%	28	41	26	4			100					14	11	71	17		1	2	97	21	53	27		
1945-1950 8 %																								
%	50	38	8		4		100					4	6	72	23				100	53	39	8		
1951-1960 18 %																								
%	52	3	18		25	2	100					2		49	51		1		99	63	35	2		
1961-1975 28 %																								
%	35		13		51	2	100					1	2	58	41		1		99	26	61	14		
1976-1982 15 %																								
%	29	3	32		34	2	78		22			1			100		1		99	27	54	19		
TOTAL 100%	No. of Homes Surveyed: 2099						2081					2101	2097			2101				2100			116	
%	36	17	20	1	24	1	96		4			5	4	52	43		1	1	98	33	51	16	0	

*Too few basements visible because of snow

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DATA SUMMARY TABLES

Location: WINNIPEG

AGE GROUP & (% of Total)	STYLE						TYPE						GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE			DEGRADATION IN:		
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	Nil	Med	Full	Settled	Poor PLACEMENT	Voids	Uniform	Low	Med	High	Basement	Attic	
Pre 1945 36 %																									
%	44	24	24	8			98			2		4	87	13				4	96	7	78	15	2		
1945-1950 12 %																									
%	76	11	12				95			5		7	80*	20					100		51	49	7		
1951-1960 17 %																									
%	93	3	1		2		100					2	59*	40				1	99	24	69	7	15		
1961-1975 26 %																									
%	72	3	20		4	2	97			3		4	11	88				2	98	47	47	6	7		
1976-1982 9 %																									
%	57	2	20	1	14	6	100					1		23	77			2	98	89	11		92		
TOTAL XXX	No. of Homes Surveyed: 2017						2008					2052	2010			2052				2010			2021		
%	65	12	17	3	2	1	98			2		4	54	39	7			2	98	27	59	14	14		

*many of the 1945-55 "nil's" may have been 'insulated" with the double aluminum foil of that time and region....essentially uninsulated.

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DATA SUMMARY TABLES

Location: CALGARY

AGE GROUP & (% of Total)	STYLE						TYPE						GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE			DEGRADATION DM:		
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	Nil	Med	Full	Settled	Poor Placement	Voids	Uniform	Low	Med	High	Basement	Attic
Pre 1945 26 %																									
%	58	31	6			5	96	3		1			5	56	40				100	34	63	4			
1945-1950 11 %																									
%	85	6	4		1	4	90	9		1			1	44	55				100	6	90	4			
1951-1960 6 %																									
%	84	2	7		5	2	100							51	49				100	9	88	2			
1961-1975 51 %																									
%	49	3	17		16	15	96	4					2	48	51				100	10	85	4	1		
1976-1982 6 %																									
%	10	8	48		4	29	74	21		4			2	48	50				100	15	75	10			
TOTAL NOS.	No. of Homes Surveyed: 744						745					751	747			751				751			538		
%	55	11	14		9	11	94	4		1		0	2	50	48				100	16	79	4	1		

Sennada

DATA SUMMARY TABLES

Location: EDMONTON

AGE GROUP & (% of Total)	STYLE						TYPE						GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE			DURATION (hr)		
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	Nil	Med	Full	Settled	Poor Placement	Voids	Uniform	Low	Med	High	Basement	Attic	
Pre 1945 38 %																									
%	59	34	4	1		1	100					1	8	55	37		1	4	95	49	47	4			
1945-1950 34 %																									
%	60	34	1			5	100						6	55	34			1	99	31	60	8			
1951-1960 19 %																									
%	73	8	5			14	98	2					13	41	46			2	98	27	62	12			
1961-1975 7 %																									
%	65	3	5		6	21	91	9					18	54	28				100	15	63	22			
1976-1982 2 %																									
%	14	5	33			48	55	35		10			10	62	29				100	14	67	19			
TOTAL NOS	No. of Homes Surveyed: 984						985 USE TOTALS WITH CAUTION					987	986 SURVEY UNDER-			987 REPRESENTS NEWER HOUSING				983			673		
%	62	26	4	1		7	98	2				0	9	52	39			2	98	36	56	8	0		

Scanada

DATA SUMMARY TABLES

Location: VICTORIA

AGE GROUP & (% of Total)	STYLE: 1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	TYPE: Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	GENERAL LEVEL OF WALL INSUL.: Nil	Med	Full	COMPLETION OF INSUL.: Sectled	Poor Placement	Voids	Uniform	AIR LEAKAGE: Low	Med	High	DURATION IN: Basement	Attic
Pre 1945 0 %																								
%																								
1945-1950 2 %																								
%	100						100					100	100						100	100				100
1951-1960 98 %																								
%	87					13	100					11	6	88	6	15	5	18	62	68	19	14	38	100
1961-1975 0 %																								
%																								
1976-1982 0 %																								
%																								
TOTAL HOME	No. of Homes Surveyed: 56 IGNORE						52 TOTALS - SURVEY NOT A					56	50 CROSS-SECTION			56				38			40	40
%	88					13	100					7	8	86	6	14	5	18	63	68	18	13	38	100

4.0 FIRST ANALYSIS OF FINDINGS

The Data Summary Tables of Section 3 are in turn summed up in a final table, overleaf. The first analysis of the findings should be undertaken with a clear appreciation of the limitations of the work (and the tabulations); these are now outlined.

4.1 LIMITATIONS

4.1.1 Weather

The late winter timing of the work was advantageous in one important respect: cases of condensation within the insulated walls were viewed at their worst, having had the whole of an unusually cold winter to accumulate. The disadvantages proved to be significant too:

- The limited time to carry out the survey (before mild spring temperatures prevented further thermography) did result in poorly-balanced cross-sectioning of some cities (refer to "normalization", next).

- Mild temperatures prohibited any surveying of Vancouver housing. (Victoria, with clear skies, did allow valid thermography on one night.) Some other areas had to be completed in slightly milder temperatures than stipulated, but the thermography was all done adequately.

Other winter effects detracted from the survey's coverage substantially. Abnormally generous snowfalls and drifts obscured the view of **basements** in very many cases. (In Victoria, the lush year-round vegetation severely curtailed the thermography run on the one cool night.) Unrelenting winds presented less-than-ideal thermography conditions in

Scanada

OVERALL DATA SUMMARY TABLE - %'s

	STYLE							TYPE						GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKAGE				INSULATION IN:	
	1 Storey	1-½ Storey	2 Storey	2-½ Storey	Split Level	Raised Bungalow	Single Detached	Semi Detached	Row/Town	Duplex	Quadraplex	MOISTURE WALL	NIL	Med	Full	Settled	Poor Placement	Voids	Uniform	Low	Med	High	Basement	Attic	
FULL SURVEYS:																										
NFLD	34	4	32		6	24	78		15	4	2	26	5	25	70		1	4	96	10	59	31	41	N/A	
PRED/ MONC	37	20	16	12	4	11	93	5		1		5	4	60	36		7	4	89	67	30	3	18	N/A	
MONT	8	1	59	30	1	1	12	16	54	4	15	✓	50	32	17	3	1	1	96	69	19	12	9	N/A	
TOR	31	12	28	17	11	1	80	19	1			0	70	25	5			1	99	16	76	8	29	N/A	
LOND	36	17	20	1	24	1	96		4			5	4	52	43		1	1	98	33	51	16		N/A	
WINN	65	12	17	3	2	1	98			2		4	54	39	7			2	98	27	59	14	14	N/A	
CALG	55	11	14		9	11	94	5		1		0	2	50	48				100	16	79	4	1	N/A	
EDMN	62	26	4	1		7	98	2				0	9	52	39			2	98	36	56	8	0	N/A	
LIMITED SURVEY - NOT FULLY REPRESENTATIVE OF HOUSING STOCK:																										
HULL	46	14	35	1		5	92	4	3			12	1	44	55				100	60	38	2	44	N/A	
EXTREMELY LIMITED SURVEY - NOT REPRESENTATIVE OF HOUSING STOCK:																										
OTT		1	58	41			40		59	1		0	19	76	5				100	14	46	20	38	N/A	
HEL	17	32	41	8			100					0	42	49	9			1	99	20	80		20	N/A	
VICT	88					11	100					7	8	86	6	14	5	18	63	68	18	13	18	100	

Winnipeg and St. John's; the stipulated 25 kph limit had to be ignored some of the time. Such instances were recorded and the analysis of thermograms was conducted with wind effects in mind.

4.1.2 Representing Whole CMA's

Since the surveyors had to survey quickly on cold nights with no way to predict the final totals that could be surveyed, it was difficult to maintain a running cross-sectioning with the numbers of houses kept roughly proportional to the actual size of the age groups in each region. Further, the loss of Vancouver to its usual early spring resulted in contingency efforts to cover Victoria and Nelson where possible, and then Edmonton and Calgary, with less time for route mapping for complete cross-sectioning. With the exception of a few cities the surveyors did manage to capture fairly representative swaths of houses by age group. It is useful and arguably safe to take the findings as valid within each age group, but beyond that some normalization should be done first:

- When attempting to assess or picture the low-rise housing stock of a whole CMA, the age groups surveyed should first be weighted commensurately to represent the actual census numbers in each group. Since that has not yet been done, the "total" summations in Section 3's Data Summary Tables should be used cautiously, as rough inferences only, and likewise the whole of the overall Data Summary, this section.

- Any rigorous attempt to assess or picture the Canada low-rise stock must clearly be preceded by weighting of the (normalized) CMA's. The survey contract called for no such attempt; St. John's and Fredericton/Moncton areas each had the same number of houses surveyed as

Montreal or Toronto. There are indeed regional distinctions in the stock types and "thermal fitness", and the use of the combined CMA results as is would impute an overly Atlantic flavour to the whole country. (A "first picturing" of the whole country's stock, using a crude "normalization", is offered in section 4.2.5.)

4.1.3 Air Leakage

The thermographers, all familiar with low-rise housing, were asked to rate each case somewhat subjectively in terms of apparent air leakage. Scanada's further review of the thermography videotapes confirmed that this had been done consistently and usefully with the insulated stock everywhere. However, the uninsulated stock presents a "white on white" problem that makes the air leakage judgements rather tenuous and not always meaningful. (The outer wall surface is relatively warm because of little thermal resistance, therefore reading as light grey or white on the thermograms. Air leaks often dissipate through the uninsulated cavities, and in any case cause relatively little further warming, "white-on-white", which can only be interpreted by painstaking resolution of isotherms - and then not always clearly.)

4.1.4 Attic Insulation

Since the presence of attic insulation does reveal itself to outdoor thermography in many cases (attic vents showing cool, not warm), the surveyors were asked to attempt such observations on all cases. This attempt succeeded adequately in Quebec's flat roof cases (reading the soffit temperature indications) but not generally elsewhere.

4.1.5 Exterior Cladding Effects

Two claddings present difficulties in reading anything but gross thermal defects or general extent and amount of insulation in the wall. Brick veneer can be particularly obstructive, because of its thermal inertia (slight amounts of solar heat can be retained on the south and west walls through much of the night) and the relatively vented air space behind it. Aluminum siding is less obstructive, but it does diffuse its surface warm/cool boundaries because of its high conductivity as well as the slightly vented (but smaller) air spaces. These effects prevented adequate surveying of air leaks, voids and internal moisture in brick veneer houses, and sometimes reduced the clarity of moisture effects and air leaks under the aluminum. Only the brick veneer stock can be considered less than adequately surveyed, perhaps affecting London and especially Montreal (as noted on its Data Summary Table in Section 3).

4.2 FIRST ANALYSES

4.2.1 The Regional Housing Stock

The observed makeup of the low-rise stock presented no surprises; the types and styles of houses had been surveyed before (by low-altitude aerial photography, and analysis of urban fire maps and other records, for the Canada 2 model; ref. 1 following the INTRODUCTION). The recently built stock is indeed dominated by raised-basement "split entry" houses in the Atlantic and the West, and Newfoundland's older housing is also dominated by the earlier manifestation of raised basements. Such houses appear somewhat disposed to air leakage and attendant moisture problems, as will be discussed in a separate paper. In the Toronto and Montreal-Hull areas, all but the recent stock is distinguished by the

proliferation of solid masonry and plank frame houses respectively - both types usually being uninsulated and difficult (just economic) to insulate. Quebec also presents great numbers of two and even three-storey rows and duplexes with flat roofs. (As mentioned before, the 3's are listed as 2½'s to fit the prepared format.) Otherwise Canada's low-rise stock is of wood frame/full attic construction, eminently insulatable if not already well insulated.

Following a simple normalization exercise the quantities of each type and style could be defined rather well from this survey. If desired, the general condition of the houses and even some indications of socio-economic category could also be gleaned from the photographic survey, and correlated with extent of retrofit insulation, for example.

4.2.2 Thermal Fitness - Insulation

Even without normalization, several of the cities were cross-sectioned well enough to allow all results to be accepted as useful approximations. The extent and level of wall insulation is indicated as:

- St. John's: 5% nil, 25% medium level*, 70% full*
- Fredericton/Moncton: 4%, 60%, 36% respectively
- Montreal: 50% nil (plank frame, primarily ?), 32%, 17%
- Hull: 1%, 44%, 55%
- Toronto: 70% nil (solid masonry, primarily), 25%, 5%
- London: 4%, 52%, 43%
- Winnipeg: 54% nil (wood frame, double aluminum foil "insulation"?) 39%, 7%
- Edmonton: 9% nil (but the Edmonton survey under-represents newer houses), 52%, 39%

*"Medium" connotes generally the presence of the once-typical R7 and R8 batts (RSI 1.2 or 1.4). "Full" may connote the presence of R10 batts, or R12, in houses of the past decade and then the last few years (RSI 1.7, 2.1), or fully filled stud space yielding R14 or more (RSI 2.5) in retrofitted older houses.

- Calgary: 2%, 50%, 48% (but the Calgary survey over-represents new houses, intentionally counterbalancing this deficiency in the Edmonton survey)

Results from other cities should be taken as indicative only within the age groups covered.

The insulated houses generally appear uniformly insulated, with only 5% indicating missing batts or other substantial voids.

Basement insulation is now fairly common in St. John's, where 41% of the basements not obstructed by snow appeared insulated; Hull, 44%; and Toronto, 29%. The small sample of basements visible despite snowbanks in Fredericton/Moncton showed only an 18% incidence of insulation; likewise Montreal, 9%; London, 0%. **The idea has scarcely caught on in the west:** Winnipeg, 14%; Calgary and Edmonton essentially zero incidence of basement insulation (but newer housing is under-represented in the Edmonton survey).

4.2.3 Thermal Fitness - Air Leakage

Emphasizing again that uninsulated houses could not always be assessed reliably or consistently, it is useful to consider that 80% or more of the housing stock in almost all regions was judged to be exhibiting air leakage in the **relatively** low to medium ranges. Newfoundland stock was rated as 59% medium, 31% high - but much of the survey had to be done in breezy conditions which could bias the qualitative interpretations of the thermography. There were essentially no surprises - air leaks were prevalent at building corners, jogs, floor headers, partitions, party walls, and window and door framing. The judgements are qualitative, expressed from experience; "medium" does not mean "moderately good" any more than it means "typically bad".

4.2.4 Moisture within the Insulated Walls

One of the main objectives of the survey was to ascertain the incidence, intensity and inferences of the general nature of this problem. The survey coverage and findings do indeed allow this objective to be reached, but special analysis has proven necessary on a great number of houses.* This work is being completed for presentation in a separate paper. Pending that, the following summary of general findings is useful:

	Apparent excessive condensation within walls - age groups 1961-82 - not usually from attic		Likewise, older houses, mostly prewar and retro insulated. - apparently run- down from attic into walls in half of these cases
St. John's	22 - 33 %		16 % and up
Fredericton/Moncton and London	1 %		15 %
Winnipeg	1 %		4 %
Edmonton, Calgary (and Nelson prewar)	0 %		0%
Victoria - only 54 bungalows and raised basement houses surveyed, 1951-60.	-	11% 1951-60	-

A substantial fraction of the above wall moisture cases appears seriously wetted, conducive to rotting. In the separate paper under preparation, attempts are being made to assess the phenomena in the light of detailed field

*Video thermography can be "played with" in the office just as in field, allowing the resolution of isotherms that help distinguish between saturation effects and air leakage warming effects.

experiences in the past three years. In this survey the intent of identifying "flueless" (electrically heated) stock - most often associated with wall moisture problems - could not be met because of the common presence of chimneys for fireplaces and wood stoves. These could not yet be differentiated visually from combustion heated houses with active flues.

4.2.5 Low-Rise Canada: A First Picture

Using only the results from the fully-surveyed CMA's, with considerable prior knowledge of the stock, it is readily practicable to weight the survey results to project a very crude but useful "first picture" of the thermal fitness of the whole of urban low-rise housing in populated Canada.[1]

Toronto and Montreal CMA's are taken to represent only themselves, since both have distinct masses of uninsulated (and difficult to insulate) low-rise stock: solid masonry in Toronto, plank frame in Montreal. Both also have substantial proportions of medium and high-rise housing, so their weightings are done[2] to reflect only their low-rise stock:

Toronto 8% of Canada low-rise
Montreal 9%
(Canada low-rise stock is taken as 6.1 million units)

The remainder of the country is represented by weighting by 1981 populations alone:

Ontario-less-Toronto (rep. by London)	28%
Quebec-less-Montreal (rep. by Hull)	17%
Atlantic (rep. by Fredericton/ Moncton and St. John's, simply averaged)	9%
West (rep. by Winnipeg, Edmonton and Calgary, simply averaged)	29%

Perhaps the survey's most serious gap is the absence of Vancouver. That is counterbalanced in part by the presence of Winnipeg: That city has a substantial fraction of uninsulated houses (due largely to the early postwar "fad" of using double, spaced aluminum foil as an "insulation") which are over-represented here in Prairie terms but thus stand in for mild Vancouver's uninsulated stock.

The other significant gaps in the survey are Eastern and Northern Ontario, Eastern Quebec, Quebec City and the Gaspé, Nova Scotia and The Territories. More rigorous normalization by age, region and urbanization could do better generally, and could utilize the partial runs too (Ottawa, Nelson, Victoria). Notwithstanding these caveats, the simple weightings given above can be used to project low-rise Canada as a whole:

Superstructure Insulation Level[4]			Insulated Basements[5]	Air Leakage (1945-1971 stock)[6]		
Nil	Med	Full	Yes	Low	Med	High
18%	42%	40%	22-33%	40%	50%	10%
of low rise stock						

Considering only the 18% (or 1.1 million) of the low-rise stock with no insulation in the walls, **more than half of these are massed in Toronto and Montreal.** The great majority of those in turn, and a significant minority of the others, are of solid masonry and plank frame construction - difficult but now economic to insulate.[7]

---

1. This simple exercise is entirely beyond the contract and is offered only as a useful indication, to be used with caution. A much more rigorous normalization of data is both feasible and desirable.

2. Toronto and Montreal low-rise stock numbers are extracted and updated from Scanada's Canada 2, Ontario and Quebec models.

3. Populations are taken from an undated "first copy.... newsletter" from Statistics Canada: "Canada Update from the 1981 Census".

4. Delineation of "full" vs. "medium" insulation by thermography is not completely certain for recent stock.

5. Insulated basements could not be scanned (because of snow banks generally, and shrubbery in Victoria) except in St. John's, Toronto, and the West, and in small portions of other CMA's. The evidence suggests that 30 to 40% of basements in central and eastern Canada are insulated, but only 5 to 10% of those in Western Canada: **Thus 22 to 33% of Canada's house basements appear to be insulated at least above grade.**

6. Since thermography may not "see" air leakage clearly in the uninsulated housing, prewar housing was excluded from this tabulated assessment. To compensate, the generally tight post-1971 stock was also excluded. Refer also to LIMITATIONS.

7. Economic application of insulations to such housing is detailed in "Insulating the Walls of Existing Masonry Houses", Scanada Consultants for Ontario Ministry of Housing and Ministry of Energy, March, 1981.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The survey method works wells: street-level thermography/photography is indeed an effective survey tool that has, in the hands of seven teams,

- defined the present "thermal fitness" levels of the walls of 13,788 houses across Canada, in essentially one critical month before spring 1982. The use of double glazed windows as reference points ("self adjusting" on each house) has yielded an adequate definition of nil, medium and full insulation, with some apparent vagueness between medium and full. On all except some older stock (uninsulated), useful indications of air leakage character and degree were also captured. Presence or absence of basement insulation was revealed in those few cities free from snowbanks.

- delineated the pattern and extent of excessive accumulations of moisture within the walls of some recently built housing and older (retro-insulated) stock

- provided a permanent record of photographs and videotaped thermography that can be referenced and studied much further than in this "first picturing" report, in terms of thermal fitness, validation and correlation with earlier or further on-site inspections or moisture probings, for example; and correlation with apparent general condition, regional attributes and socio-economic attributes. Since every unit is identified and traceable by street and number, apparently troubled units or puzzling units can now be selected from the survey and studied definitively in the field.

The thermography/photography interpretations have been formed into a computerized data base from which a rebalanced "first picture" of Canada's low-rise housing has been developed:

- About 18% (1.1 million) of the low-rise stock has completely uninsulated walls. More than half of these are in Toronto and Montreal, primarily solid masonry and plank frame respectively. (These are difficult but now economic to insulate. The remainder are wood frame, easy, safe and most economic to insulate.)

- About 42% or more are moderately insulated in the walls, while 40% or less are fully insulated. (It may be economically worthwhile to add further insulation within or on moderately insulated walls, i.e. presently having R7 or R8 (RSI 1.4) batts.

- Although foundations were hidden by snowbanks in many cities, those that were scanned suggest that only 22-33% of Canadian basements are insulated.

- While much of the insulated stock appears to be fairly airtight in the walls and wall-to-roof junctions, 50% appears to be moderately airleaky and 10% highly so.

- Regionally, peculiarities are apparent and significant. In addition to the distinct Toronto and Montreal uninsulated stock, half of Winnipeg's housing is uninsulated in the walls, probably due to the postwar sweep of double aluminum foil "insulation" in that region particularly. One third of St. John's newer housing appears to be significantly troubled with excessive moisture within the walls. (St. John's walls also appear more air leaky than generally observed elsewhere.) One tenth of older housing on both coasts appears to have similar accumulations, but this often appears to be due to rundown of water from attic condensation (and/or ice dams) in these older houses. Similar patterns were seen in older houses in Moncton/Frederiction, Hull and London, and in Winnipeg to a lesser extent. (Due to mild weather, it

was not possible to scan any newer houses on the West Coast; insulation and moisture questions there are left largely unanswered.)

Recommendations

The data base should be reviewed for maximum utilization, carrying out adequate validation and gap-filling where needed. For example, in no order of priority:

- Analysis and correlation of obvious retrofit insulation, and nil insulation, with wall and attic moisture problems.

- Follow-up scanning and field probes of moisture "flagged" houses in early winter to see if summer drying has taken place.

- Quick re-scanning of the several cities that were snow-blocked, especially to complete the picture of basement insulation.

- Analysis of data base, and field probing, to determine if there is indeed a strong correlation between excessive structural moisture and air leaky walls / raised basement houses / flueless houses / full insulation, in recently built stock especially on the coasts.

- Field probing of Winnipeg/Toronto/Montreal uninsulated stock: Is it primarily what the surveyors think it is?; Is it insulatable?

- Production of a basic **Low-Rise Canada** reference book - delineating the stock (by age by region) in terms of physical and thermal condition - for public and private sector use.

- Revamping and updating the "Canada Model" approach to project quantifications of conservation markets, measures, effects, costs, cost-benefits, resource demands, and public and private sector policy opportunities.

APPENDIX A

HOUSING THERMOGRAPHY/PHOTOGRAPHY SURVEY

Technical Guidelines and Specification

HOUSING THERMOGRAPHY/PHOTOGRAPHY SURVEY

Technical Guidelines And Specifications

1.0 INTRODUCTION:

The intent of these guidelines and specifications is to establish set procedures and formats to ensure regional consistency for the seven thermography studies carried out across Canada during the months of February and March 1982.

2.0 PREPARATION FOR FIELD RUNS:

As mentioned in previous letters from R.E. Platts, this survey requires some preliminary preparation to ensure that meaningful data is collected efficiently in the field. Much of this preliminary work should now be in process and the following information is included as further guidance and should ensure that all work is being produced in a similar manner:

2.1 CMA* Mapping By Residential Age Group

- A copy of A.E. LePage's "The Relocation Book 1981" is attached and should prove to be an excellent initial guide for establishing CMA residential age groups. In some cities more input will still be required from real estate agencies, planning departments and/or residents. In some cities the local CHIP office may have data that reflects house age by address.

- The age groups remain the same as indicated in the letter

* Census Metropolitan Area

should be in this category. Percentage breakdowns by age for each province in the survey have been calculated and are shown on the following table:

Newfoundland	21%	8%	21%	36%	14%
New Brunswick	35%	12%	12%	29%	12%
Quebec	33%	9%	19%	29%	10%
Ontario	33%	8%	19%	29%	11%
Manitoba	35%	10%	17%	28%	10%
Alberta	18%	9%	21%	34%	18%
British Columbia	21%	10%	18%	37%	14%

2.5 Identify Electrically Heated Housing*

The best contact to identify electrically heated houses in any CMA is the marketing division of the local Hydro. In most cases, the houses will be clustered in a neighbourhood and built by one builder. Contacting local builders may also help to identify the house. At least 100 electrically heated houses should be positively identified and included in the survey.*

2.6 Vehicle Preparation

During the preparation of your car or van ensure that it is well marked with slow moving vehicle reflective triangles, front and back. We have found a van to be preferable in areas of heavy snow to permit looking over the street snowbank.

* The field crews were unable to differentiate between combustion heated houses with active flues, and essentially flueless (electrically heated) houses having a flue for a fireplace and/or a wood stove. Therefore, this category on Table 2.0 has been ignored in all results and analyses.

of January 28, 1982;

A - Prewar (Pre 1945)
B - 1945 - 50
C - 1951 - 60
D - 1961 - 75
E - 1976 - 82

2.2 Maps

In Ontario the best source for maps is the Pathfinder Air Surveys Ltd. series of street maps. The maps contain all street names and include symbols to represent individual housing units.

For cities in other provinces, except the Maritimes, Military City Maps have been included, as these maps distinguish residential areas by shading.

Local planning offices should be contacted to determine if more suitable maps are available.

2.3 Tables

Tables have been prepared to tabulate most of the data required for the Thermography/Photography Survey. An original quality copy of each table has been included that will permit each company to have the desired number of copies made. The copies should be bound into some form of binder.

2.4 Proportioning Housing Stock Survey By Age

The Thermography/Photography survey should be designed to proportion the housing stock samples by age; i.e., if 12% of the CMA's housing stock is in the age bracket 1945 - 1950, then 12% of the total number of houses surveyed

3.2 Data Tables

Data tables have been set up to correlate with rolls of 20 exposure colour slide film. The first table correlates house numbers, video and photographic data to street addresses.

The second table records the pertinent thermography survey information and initial interpretation of the thermographic survey.

Table 1.0

Location
Sheet No.
House #
Std. Photo Date — Roll #
Slide #
Address

Table 2.0

Location
Sheet No.
House #
Age
Style
Type
Moisture

3.3 Standard Colour Slides

One normal daytime colour slide is required for each house included in the survey.

- Suggested film type
  20 Exp. Colour Slide Film ASA100
  (such as Photo King 135-20 @ $3.99 ea. incl. processing).

3.0 COLLECTION OF NON-IR FIELD DATA:

If time permits, it is preferable to collect the data outlined in this section prior to the IR scans. Non-IR Field Data could be collected by a different crew during the day prior to the evening thermographic survey.

3.1 Maps

The inspection route should be clearly mapped out prior to the IR scan. An overlay transparancy should be used to identify items such as house numbers and side of street scanned. Refer to Attachment A which shows an example of a completed map.

It is important at this stage to clearly allocate house numbers to specific units. The house number shall be assigned on the following basis. Preceeding each house number there must be a letter that represents the CMA.

St. John's	-	S	
Moncton	-	N -	New Brunswick
Fredericton	-	N -	
Montreal	-	M	
Ottawa/Hull	-	O	
Toronto	-	T	
London	-	L	
Winnipeg	-	W	
Edmonton	-	E	
Calgary	-	C	
Nelson/Victoria/ Vancouver	-	V	

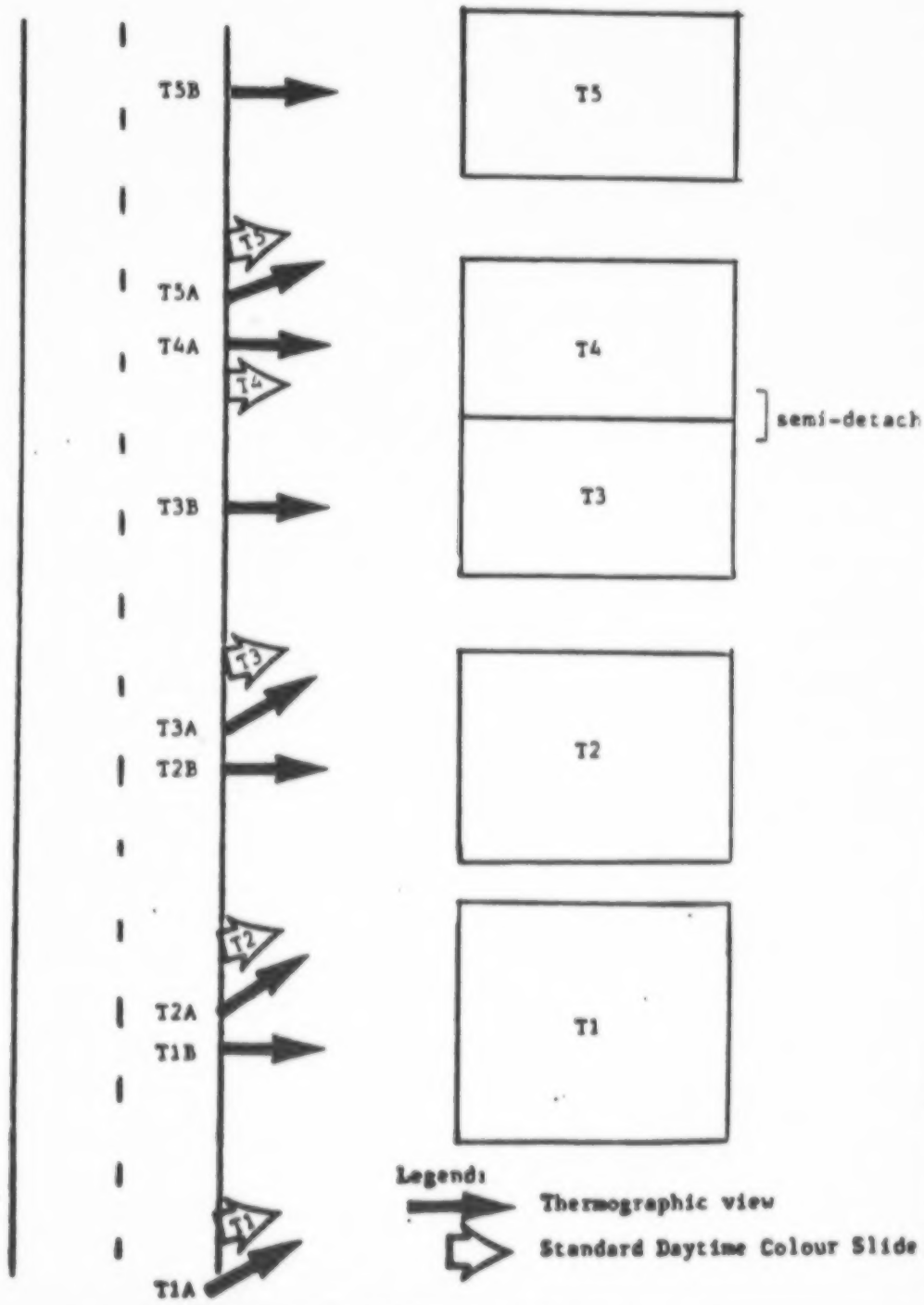
e.g. T215, T216, T217, etc.

Then, the units should be numbered consecutively from start to finish.

Scanada Consultants Limited

Project	By D. S. Lenahan	Page of
Job No S.8218 Job Title HOUSING	Date Feb. 15, 1982 THERMOGRAPHY SURVEY	

Diagram 1.0 - ORIENTATION OF PHOTOGRAPHIC AND THERMOGRAPHIC SURV



- The 1st slide on each roll should shown the first house of the roll and include a person standing in the photo holding a number to represent the roll number.

- Each slide to be clearly marked with house number.

- Refer to diagram 1.0 which shows the intended orientation of the slide.

- Slides are to be submitted to Scanada in slide cube containers that hold 40 slides per cube. These cubes should be suitable for use in a Bell & Howell Cube Slide Projector.

4.0 COLLECTION OF IR FIELD DATA:*

4.1 Video Tapes

The infrared video tapes should be produced according to the following guidelines:

- The scanning sequence should include a clear steady view of one side and the front of each house. Refer to diagram 1.0 which shows the intended orientation of the scanning.

- Each view should be held steady for at least a count of 5 to permit thermograms to be produced from the video tape.

- The vehicle speed will be 5 mph or less to ensure steady IR images.

*Equipment in all cases shall be AGA Thermovision Model 750 or successive models.

- The vehicle should be fully stopped when a thermogram is taken to ensure a crisp image.

- Each slide should be clearly marked with the house number.

Note: For companies that are not recording IR data on video tape at least 2 - 35 mm slide thermograms are required for each house inspected. These slides shall be labelled as follows: L 382 A and L 382 B to designate A and B views of house number 382 in London.

4.3 Completion of Table 1.0 and Table 2.0

Table 1.0 and Table 2.0 must be completed during the collection of the infrared images.

Information that is required to complete Table 1.0 is as follows:

Date:

IR Video Data	Tape #
	Counter #
IR Photo Data	Roll #
	Slide #

Time:

Weather:

Socio-Economic Characteristics:

Information that is required to complete Table 2.0 is as follows:

Date:

Moisture: Moisture Signs in Walls

- indicate if moisture signs appear to be present.

- In order to ensure regional consistency in the thermography scanning and interpretation, sealed double glazed or double windows shall be used as a benchmark. Adjust the level with the isotherm set at .70 to highlight the window glazing on the lee side of the structure. In Toronto at -10.7°C Range 2 was used. If the level is moved from this setting during the scanning to "look at" other details this change should be noted on the voice trace of the video and returned to the normal setting prior to scanning the next house.

- At the start of each new video tape the tape counter must be reset to zero.

- Label each video tape with the following information:

  Company Name
  CMA Name
  CMA District
  Tape Number
  House # ____ To House # _____

- All conversations/comments made during the infrared scan should be recorded on the video tape.

4.2 IR 35mm Slides

It will be necessary to take 35mm slide thermograms during the field survey to represent a typical housing unit in each neighbourhood. Thermograms that represent examples of defective units should also be taken. The following guidelines should be followed:

- Recommended film type

  Kodak Ektachrome ASA400 ER 135-36 Exp.
  (Polaroid not acceptable)

Thermographer:	- Operate AGA system - Call out house characteristics
Data Recorder:	- Operate video system - Complete Table 1.0 and Table 2.0

5.0 WEATHER RESTRICTIONS:

As a specific guide, the ASTM Draft Standard should be reviewed.

In general, the following guidelines should be followed for this survey:

- Ensure that the exterior surfaces of the buildings are dry, i.e., do not scan during or a short time after precipitation.

- Wind speed should be 15 mph or less.

- Temperature difference between indoor and outdoor air should be at least 15°C. It is preferable that the exterior air temperature be below 0°C.

- The inspections should be done at night to eliminate direct solar gain problems. In light frame houses, it generally takes 2 hours for the exterior to cool down. In heavier construction, e.g., solid masonry, it may take as many as 8 hours to dissipate the direct solar gain.

Weather data should be clearly tabulated during the infrared inspection and for 3 days prior to the inspections. The following information should be included:

General Level of Wall Insulation: Nil, Med., Full

- mark the category that best describes the house.

  Nil - no sign of insulation present

  Med. - moderate levels of insulation, say R8 batts

  Full - house has substantial insulation present, say R12 - R20 +

Completion of Insulation: % Void

- state a % of the walls that contains voids

Air Levels: Low, Med., High

- identify the air leakage level

Insulation: Attic, Gable End (in 1½-storey only), Basement

- if this information can be determined, the presence of insulation in these areas should be identified with a check (✓) mark. If insulation is definitely not present, indicate this with an ("X").

During the completion of these tables, the microphone for the video should be left on and any other comments should be read into the tape.

4.4 Suggested Personnel

Based on trial runs, it appears that the following crew is required to effectively record the information during the infrared survey.

Driver:

- Drive the vehicle
- Verify numbers
- Indicate house numbers to the thermographer
- Clearly map out the route followed

Attachment A

Map Example

Technical Guidelines and Specifications

Temperature (maximum and minimum)
Wind Speed
Wind Direction
Relative Humidity
Precipitation
Cloud Cover

6.0 TRANSFER OF FINDINGS:

At the completion of the Thermography/Photography survey, the following information is to be forwarded to myself:

David W. Bailey, P. Eng.,
Scanada Consultants Ltd.,
446 Reynolds Street,
Oakville, Ontario.
L6J 3M4

The data is to be in the following format:

Maps:	Shall be identified as outlined in Attachment A.
Video Tapes:	Original tapes labelled as described in Section 4.1.
IT Slides:	Original slides, clearly labelled with house numbers in labelled slide cubes.
Daytime Slides:	Original slides, clearly labelled with house numbers in labelled slide cubes.
Tables:	Table 1.0 and Table 2.0 are to be completed and in a format suitable for Xerox reproduction. Refer to Attachment B which shows examples of completed tables.

Scanada Consultants Limited

Project	Attachment A Map Example	By DSL Date Feb. 15, 1982.	Page of
Job No S.8218	Job Title Housing	'Thermography Survey	

Attachment B

Examples Of Completed Tables

Technical Guidelines and Specification

Scanada

Table 1.0

THERMOGRAPHY SURVEY

Location: Toronto

Date: Feb 15, 1982

Sheet No.: 1A

HOUSE #	IR VIDEO DATA		IR PHOTO DATA		STD. PHOTO DATA		ADDRESS
	Tape #	Counter #	Roll #	Slide #	Roll #	Slide #	
T 1	1.	001	1	1	1	1	25 Parkwood Dr
2		005					27
3		011					29
4		014					31
5		021					33
6		026					35
7		029					37
8		035					39
9		042					41
T 10		052					43
T 11		051					45
2		058					47
3		063	1	2			10 Lakeview Cres.
4		074					12
5		091					14
6		099					16
7		105					18
8		110					20
9		121					22
20		128					24

Comments: (Time, weather, socio-economic characteristics, etc.)

Feb 15 /82 11:00 PM Clear Sky, No Precip. Wind Nil, Temp -10.7 °C

Parkwood: Solid Masonry homes [illegible]

TABLE 2.0

Scanada

THERMOGRAPHY SURVEY

Location: Toronto

Date: Feb 15, 1982

Sheet No.: 1 B

House #	AGE					STYLE						TYPE					MOISTURE	GENERAL LEVEL OF WALL INSUL.			COMPLETION OF INSUL.				AIR LEAKS		INSULATION ?	
	Pre 1945	1945-1950	1951-1960	1961-1975	1976-1982	1 Storey	1-1/2 Storey	2 Storey	2-1/2 Storey	Split Level	Raised Bung.	Single Det.	Semi Det.	Row/Town	Duplex	Flueless	Moisture Signs in Walls	Nil	Med.	Full	Settled	Poor Placement	Voids	% Void	Low	Med.	High	Gable End	Basement	Attic
T 1	✓							✓				✓						✓									✓		✗	
2	✓								✓			✓						✓									✓		✗	
3	✓							✓				✓					✓	✓									✓		✗	
4	✓							✓					✓					✓									✓		✗	
5	✓								✓				✓					✓								✓			✗	
6	✓						✓					✓						✓									✓		✗	
7	✓							✓				✓						✓								✓			✗	
8	✓							✓				✓						✓									✓		✓	
9	✓							✓				✓						✓									✓		✗	
T 10	✓						✓					✓						✓											✓	
T 11	✓								✓			✓						✓									✓		✗	
2	✓						✓					✓						✓									✓		✗	
3		✓						✓				✓					✓	✓									✓	✗	✗	
4		✓						✓				✓							✓			✓				✓		✗	✗	
5		✓						✓				✓						✓									✓	✗	✓	
6		✓					✓					✓							✓				✓	✗		✓		✗	✗	
7		✓						✓				✓						✓								✓			✓	
8		✓							✓			✓						✓								✓			✗	
9		✓					✓					✓						✓								✓			✗	
T 20		✓						✓				✓						✓								✓		✗	✓	

POOR

QUALITY

ORIGINAL